Disorganised theories or disorganised attachments: An analysis of the

divergence between attachment and psychopathology models explaining the

early emergence of callous-unemotional traits

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ORIGINALITY AND ATTRIBUTION STATEMENT

I hereby declare that to the best of my knowledge the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources has been acknowledged.

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ABSTRACT

Previous findings have convincingly suggested that children with callous-unemotional (CU) traits have a disorganised attachment. This reveals a significant conflict between established developmental frameworks, as the literature on children with CU traits places most of the aetiological burden on the child, whereas the attachment literature places most of this burden on the parent. The divergence between models was examined in four studies.

Study 1 examined the intergenerational transmission of CU traits. This cross-sectional study used a sample of clinically-referred children to investigate whether psychopathy in parents conferred risk specific to CU traits over and above general risk variables such as harsh parenting, low warmth, or parental psychopathology.

Study 2 validated two psychometric tools: the Interview on Critical Bonding Moments (ICBM), a retrospective assessment of parents' state of mind through their child's early development, and the Child Affective Behaviour (CAB) scale, which assesses children's proximity-seeking, eye gaze, soothability and expression/reception of affect in a single dimension. The internal structure and validity of these tools was assessed with a mixed clinical-community sample.

Study 3 was a cross-sectional assessment of relationships between CU traits and the ICBM and CAB, using a Bayesian machine-learning algorithm to probe whether both maternal negative affect during critical bonding experiences, and children's affective responses, would be associated with parental reports of CU traits.

Study 4 investigated longitudinal associations between retrospective markers from Study 3 and the development of CU traits when children were 4. The sample consisted of mother-child dyads assessed over a four-year period. Results from Study 3 were replicated,

and the analysis uncovered novel longitudinal associations suggesting children's dispositional characteristics are the main predictors of CU emergence.

The case for a child-driven effect received considerable support, as studies revealed strong associations between children's affective behaviours and the emergence of CU traits, in results consistent with predictions from the CU literature. Assessments guided by an attachment framework accounted for smaller but significant effects, linking the perinatal period to the emergence of CU traits in novel associations with maternal fright during pregnancy and disinterest while feeding.

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INTRODUCTION

The idea that emerging psychopathology and disturbed attachments go hand in hand has been a centrepiece of development psychopathology for several decades (Bowlby, 1969; Cyr & Alink, 2017; Fearon & Roisman, 2017). A failure to provide children with predictable, secure caregiving experiences confers risk for most behavioural and emotional problems (Bohlin, Eninger, Brocki, & Thorell, 2012; Fearon, Bakermans-Kranenburg, Van Ijzendoorn, Lapsley, & Roisman, 2010; Groh, Roisman, van Ijzendoorn, Bakermans-Kranenburg, & Fearon, 2012; Kim, Kochanska, Boldt, Nordling, & O'Bleness, 2014; Madigan, Atkinson, Laurin, & Benoit, 2013); conversely, behavioural and emotional problems in children present enormous challenges to caregivers (Brown, Granero, & Ezpeleta, 2017; Hawes, Dadds, Frost, & Hasking, 2011; Kochanska, Boldt, Kim, Yoon, & Philibert, 2014; Waller et al., 2014; Waller & Hyde, 2017a; Zheng, Pasalich, Oberth, McMahon, & Pinderhughes, 2017). But has decades of theory and research into these relationships uncovered any precise interaction between specific attachment processes and individual differences in manifestations of psychopathology over and above the blanket notion that secure attachments and mental health go hand in hand?

This thesis argues that there are areas of tension, if not outright contradiction, in recent findings of attachment types and specific forms of childhood disturbance that are critically important for progress in developmental psychopathology. Specifically, this thesis argues that the literature regarding children with callous and unemotional traits places most of the aetiological burden on the child (genetic influences, abnormal brain structures, antenatal hardship); in contrast, the literature on attachment disorganisation places most of this burden on the parent (frightening behaviours, maltreatment, insensitive parenting), and findings suggest that children with callous and unemotional traits tend to display a

disorganised attachment (Pasalich, Dadds, Hawes, & Brennan, 2012). Synthesising these divergent explanations of emerging dysfunction – in this case high levels of CU traits - provides an opportunity to compare, contrast, and clarify various aetiological models of both CU traits and disrupted attachment, as well as the relationship between them.

To unpack this relationship the thesis is divided into five sections, examining: (1) the emergence of CU traits, (2) studies focusing on CU traits and attachment; (3) attachment and disorganised attachment; (4) contradictions between these accounts; and (5) specific predictions based on these contradictions.

Callous-unemotional traits

The most reliable indicator of persistent and severe patterns of externalising behaviours is a group of features described as callous and unemotional (CU) traits (Frick, Ray, Thornton, & Kahn, 2014; Hawes & Dadds, 2005; Kimonis & Armstrong, 2012; Miller et al., 2014). CU personality traits are individual characteristics, like a lack of empathy or blunted affect, which have been associated with antisocial behaviour in conduct problems (Frick, Ray, Thornton, & Kahn, 2014; Viding & McCrory, 2012). The concept of "CU traits" was developed by Paul Frick, who adapted the adult-psychopathy literature for use in children to bolster early interventions. CU traits are normally distributed across the population, but are over-represented in recidivists, psychopaths, and other groups associated with severe externalising problems (Frick et al., 2014). CU traits are associated with conduct disorder (CD) severity and aggression (Frick, Cornell, Barry, Bodin, & Dane, 2003). This is particularly troubling as these children do not respond to treatment as well as most (Frick et al., 2014), as CU traits predict treatment outcomes independently of the parents' implementation of treatment or the severity of the initial diagnosis (Hawes & Dadds, 2005; Hawes, Dadds, Brennan, Rhodes, & Cauchi, 2013; Hawes, Price, & Dadds, 2014). The

importance of these findings is reflected in the DSM-5's inclusion of a CU-specifier for the CD diagnosis. The specifier, "With Limited Prosocial Emotions", was added as a substantial body of evidence suggested worse outcomes for individuals to whom the specifier applied (APA, 2013; Frick & White, 2008). CU traits are therefore defined in the DSM as persistent (>12 months) characteristics (2 or more of the following), which occur over multiple settings and relationships: (a) lack of remorse, (b) callous lack of empathy, (c) lack of concern about performance, and (d) shallow or deficient affect. This combination of worse outcomes and increased reliability singles out children with CU traits as a population well-suited for the study of *mechanisms* of psychopathology. As demonstrated below, it is likely that the intergenerational transmission of unempathic and callous responses is a main driver of CU traits.

Intergenerational Transmission of CU Traits

The first step in investigating the role of affective interpersonal processes in the emergence of CU traits is to understand where these characteristics come from. While both genetic and psychological processes are known to influence early pathways leading to CU traits, it is surprising that little research has looked at the stability of CU traits across generations of parents and children, particularly as other studies have associated parenting dimensions with prospective CU traits (Hawes et al., 2011; Pardini, Lochman, & Powell, 2007). Previous studies have suggested that the CU construct may even differ between age groups: for example, studies using adolescents attributed around 42% of the variance in CU traits to genetic factors (Larsson, Andershed, & Lichtenstein, 2006; Taylor, Loney, Bobadilla, Iacono, & McGue, 2003), while studies in early childhood produced estimates as low as 25% (Tuvblad, Fanti, Andershed, Colins, & Larsson, 2016). Waller and colleagues (2016) conducted a recent investigation on the heritability of fearlessness and affiliative behaviours in a sample of adopted children. They found that fearlessness and affiliative behaviours from

biological mothers were significant predictors of the children's CU traits at 27 months. These influences were partly mitigated by high levels of positive parenting from adoptive mothers. Adoptive fathers' positive parenting did not mitigate the biological influences. These studies show that different parental traits can influence the development of CU traits, but do not clarify whether psychopathy traits in parents are particularly strong predictors of CU behaviours.

Two studies have looked at the intergenerational stability of either CU traits or psychopathy scores in isolation. Kahn, Deater-Deckard, King-Casas, and Kim-Spoon (2016) used a community sample consisting of 115 parent-child dyads, in which most parents surveyed were mothers (87%). This study found that parent and adolescent CU scores were not significantly correlated. However, mediation modelling indicated parental CU traits were a significant predictor of adolescent CU traits (Kahn et al., 2016). These models also revealed that hostile parenting – under conditions of high household chaos – mediated the relationship between parental CU traits and adolescent CU traits. Auty et al. (2015) similarly investigated the continuity of psychopathic traits, using 419 father-child dyads from a longitudinal study spanning two generations (Auty et al., 2015). These authors analysed psychopathic traits following the Hare & Vertommen model (1991) which divides psychopathic traits into two factors (1 and 2). Factor 1 designates characteristics associated with a psychopathic personality, such as lack of empathy, shallow affect, superficial charm, and manipulativeness. Factor 2 is associated with antisocial behaviours, such as delinquency and impulsivity.

Auty et al. (2015) found that paternal scores for both factor 1 and factor 2 were associated with their offspring's factor scores, such that high factor 1 scores in fathers predicted high factor 1 scores in both sons and daughters. Importantly, the direct effect of the father's factor 1 scores on their male son's factor 1 scores was greater than the indirect effect (variables included in a mediation analysis did not account for a large part of the effect). This

was not true for daughters, for whom their father's factor 1 scores exerted a stronger indirect effect (the mediation model including parental psychosocial risk-factors was stronger). These findings were reversed for factor 2 scores, such that the indirect effects were strongest for male children, while the direct effects were somewhat stronger for female children. Taken together, these studies indicate that factor 1 scores are important for intergenerational stability of CU traits, though it is unclear whether this relationship would be maintained in the presence of psychosocial risk factors like harsh parenting or paternal drug use. These studies investigated either CU traits or psychopathy traits in isolation, but not the relationship between the two.

Only two studies to date have used measures of parental psychopathy as predictors of children's CU traits. Loney, Huntenburg, Counts-Allan, and Schmeelk (2007) used a sample of children recruited from a school district (representative of the variability of conduct problems within the district) and their mothers to assess which maternal dimensions of psychopathy were predictive of the children's CU traits (Loney et al., 2007). They found maternal psychopathy factor 1 to be significantly associated with children's CU traits. This relationship, however, was fully mediated by the mother's parenting behaviours (dysfunction and hostility), such that when parenting behaviours were taken into account the association between the mother's psychopathy factors and the child's CU traits ceased to be significant. Loney et al.'s (2007) study is an important initial examination of the transmission of these traits, though it suffers from a relatively small sample size (n = 83), which included fewer boys (38) than girls (45) and only evaluated maternal traits.

The second study, by Hyde et al. (2016) investigated the influence of biological and adoptive mothers on children's development of CU behaviours (Hyde et al., 2016). Hyde and colleagues (2016) used a sample of 561 families which formed part of a prospective adoption study, collecting data on both adoptive mothers' positive parenting and biological mothers'

antisocial behaviours. This study produced two important findings. First, both the biological mothers' antisocial behaviours and the adoptive mothers' positive strategies were related to the child's CU behaviours. Second, the interaction between these factors was significant, such that biological mothers' antisocial behaviour was predictive of CU behaviours only under conditions of low maternal positive parenting. Indeed, when adoptive mothers' positive reinforcement strategies were high, biological mothers' antisocial behaviours were no longer predictive of CU traits. Note that, as with Loney et al.'s (2007) study, Hyde et al. (2016) only investigated maternal, and not paternal traits.

In order to make stronger inferences a number of methodological issues must be considered. First, the use of gender-specific samples (Auty et al., 2015; Loney et al., 2007) or gender-biased samples (Kahn et al., 2016) – curtails the ability to draw non-gender-based inferences, which may be important in understanding the role of mediating factors. For example, Auty et al. (2015) found different predictors were important depending on the gender of the children of psychopathic parents. Some studies have found females are less likely to express CU traits (Essau, Sasagawa, & Frick, 2006; Fontaine, Rijsdijk, McCrory, & Viding, 2010), while others have found males to have a stronger association between genetic influences and CU traits (Fontaine et al., 2010). Silverthorn & Frick (1999) argue that females might have a delayed onset of antisocial behaviours due, in part, to a higher susceptibility to environmental (family) dysfunction (1999). Research investigating the relationship between eye-gaze deficits, fear recognition, and CU traits found that fathers, but not mothers, showed a similar impairment to their high-CU children (Dadds, Jambrak, Pasalich, Hawes, & Brennan, 2011). It is also likely that family interactions are influenced by gender, as shown previously in Fredricks & Eccles's (2004) study on sport motivation and McHale and colleagues' study on gender development (2003). Altogether, these differences

suggest it is important to test for different pathways in male and female participants when seeking to understand the role of parental psychopathy in the development of CU traits.

Second, although the studies mentioned above applied mediation analyses (Hyde et al., 2016; Kahn et al., 2016; Loney et al., 2007), the variables included were not theoretically exhaustive, and captured only certain aspects of psychosocial risk (e.g. parenting dysfunction or drug use), while excluding others (e.g. warmth or mental health) known to be of interest. Maladaptive parenting practices and parental mental health, both of which are associated with the development of negative mental health outcomes, were not assessed in all studies assessing intergenerational stability of CU traits (Cummings, Keller, & Davies, 2005; Pettit, Bates, & Dodge, 1997; Prinz, Sanders, Shapiro, Whitaker, & Lutzker, 2009). Likewise, warmth appears to be important in the maintenance and development of CU traits, an association explored in depth below (Elizur, Somech, & Vinokur, 2017; Kochanska, Kim, Boldt, & Yoon, 2013; Pasalich, Dadds, Hawes, & Brennan, 2011b; Pasalich, Dadds, Vincent, et al., 2012; Waller, Gardner, & Hyde, 2013a; Waller et al., 2017).

Together, these studies suggest a role for both genetic inheritance and parenting in the emergence of CU traits. In what follows, the associations between parenting and the development of CU traits will be explored within one of the best researched frameworks for understanding early parent-child relations in developmental psychology: attachment theory.

Attachment theory

Attachment theory refers to a biologically-grounded behavioural system driving individuals to seek proximity, security, and responsiveness from an "attachment-figure" (Ainsworth, 1967; Bowlby, 1969; Rutter, 2014). A child's attachment system evolves from relationship-specific bonds to primary caregivers in infancy (from birth to 1-2 years), to an internal mental model throughout late childhood (from 3-5 years onwards) and adolescence

(Cassidy, 2008; Weinfield, Stroufe, Egeland, & Carlson, 2008). This system is not perpetually active; instead, the system is engaged when the child is under conditions that increase the likelihood of danger, such as distress, loud noises, darkness, or other similar threats (Mikulincer & Shaver, 2010). It is generally accepted that behaviours displayed when the attachment system is active (among a specific dyad) can be categorised into distinct groups, commonly referred to as attachment categories, of which there are four: secure (B), avoidant (A), resistant/ambivalent (C), and disorganised (D). These categories can also be grouped as secure versus insecure – with the latter made up of categories A, C and D. These attachment categories are thought to be strongly influenced by the parents' own attachment styles, as shown by research in which parent-child attachment styles are concordant. Van Ijzendoorn (1995) reports meta-analytic findings in which there is a 75% agreement between mother and child attachment categories (secure vs. insecure), in results replicated in longitudinal studies showing 72% agreement between mother and child attachments – albeit in a small sample (Waters, Merrick, Treboux, Crowell, & Albersheim, 2000). In this sense, even though attachment categories are considered emergent properties of specific dyadic relationships, caregiver's previous attachments hold substantial influence over the child's own attachment style. As these attachment styles go on to become a lens through which children experience the world, insecure attachments are thought to contribute to the development of maladaptive interpersonal relationships.

Critically, insecure attachment styles have been associated with a plethora of negative outcomes, including externalising and internalising disorders (Fearon et al., 2010; Groh et al., 2012). Meta-analyses show that insecure attachment classifications in adulthood are associated with experiences of abuse, PTSD, depression, and eating disorders (Bakermans-Kranenburg & van Ijzendoorn, 2009; Kuipers & Bekker, 2012), as well as other adverse outcomes, such as substance abuse (Schindler & Bröning, 2015). Hence, attachment presents

an intriguing framework with which to examine childhood characteristics associated with aggression and interpersonal problems, such as CU traits. After all, the idea that emerging psychopathology and disturbed attachments go hand in hand has been at the centrepiece of development psychopathology for several decades (Bowlby, 1969; Cyr & Alink, 2017; Fearon & Roisman, 2017).

Callous unemotional traits and attachment

The first study to examine attachment in children with CU traits was conducted by Pasalich, Dadds, Hawes & Brennan (2012). This study focused on a clinical sample of 55 boys with high CU traits and concurrent conduct problems (CP). Attachment patterns were assessed using the Manchester Attachment Story-Completion Task (Green, Stanley, Smith, & Goldwyn, 2000), a procedure in which the experimenter begins an attachment-related narrative and asks the child to finish the story (e.g. "Little Josh is playing with his bike while mum does the dishes. Oh no he fell down and hurt his knee! What do you think happens next?"). In Pasalich and colleagues' (2012) study 75% of children with CU traits had insecure attachment styles, with 56% being classified as disorganised and 19% as avoidant. Results from a logistic regression showed that disorganised attachment was a significant predictor of attachment classification independent of children's age or maternal education. These results were surprising for two reasons: first, the lack of concern towards interpersonal relationships demonstrated by children with elevated levels of CU traits had been initially associated with an avoidant, and not a disorganised, attachment. Second, the association between CU traits and attachment disorganisation rested on the premise that attachment disorganisation is associated with a higher incidence of antisocial behaviour. Neither assumption was supported in the study.

First, the association between avoidant attachment and CU traits was unlikely from the start, as only 7 children had been diagnosed as having an avoidant attachment, and only 3 of these had high levels of CU traits. Unsurprisingly, a model predicting avoidance on the basis of CU traits, age, and maternal education failed to reach significance. As for the second assumption, the authors report that there was no association between attachment categories and conduct-problem symptoms, even though the association between disorganisation and externalising symptoms is robust (Fearon et al., 2010). Authors therefore conclude that their sample "show[s] that high CU/conduct-problem children raised in relatively typical family environments also exhibit disturbed [insecure] attachment relationships." (p. 842, Pasalich et al., 2012). These results demand further examination of exactly what was meant by "attachment disorganisation" and why children with elevated levels of CU traits had higher rates of these features.

Attachment disorganisation in the MCAST is diagnosed when the child fails to react in a consistent manner across different stories. Inconsistent behaviour tends to take the form of either aggressive behaviour or freezing when invited to continue the story. For children included in this study ($M_{age} = 6.31$; SD = 1.80), reactions to the story stem task are meant to exemplify the child's internal representations of dyadic responses to attachment threat (separation; stressors such as pain, a stranger, etc.). The meaning of attachment disorganisation will be discussed in the second section; for now, it is enough to note that attachment disorganisation was present in children with relatively typical family histories and elevated levels of CU traits.

This same pattern of results was observed in Bohlin and colleagues' (2012) study. Bohlin and colleagues (2012) used a sample of 65 children (54 boys, 11 girls), 20 of whom had been identified as "at risk" for developing attention-deficit hyperactivity disorder (ADHD) and/or oppositional defiant disorder (ODD). The children were assessed in a variety

of measures (Brocki, Nyberg, Thorell, & Bohlin, 2007), including CU traits (with eight items from "The Child Problematic Traits Inventory", Andershed, 2007) and attachment patterns (with the "Attachment Doll Play Classification System", George and Solomon, 2000). The attachment classification system used in this study was similar to that described by Pasalich et al. (2012), and children were of a similar age range ($M_{age} = 5.5$; SD = 0.70), making comparisons across studies particularly relevant. Bohlin et al.'s (2012) study found that disorganised attachment was significantly correlated with CU traits ($r = 0.50$, $p < .01$). Furthermore, in a hierarchical regression using disorganised attachment classification at age 5, the authors were able to predict CU traits at age 7 ($sr^2 = .14$, $p < .01$), ADHD behaviours ($sr^2 = .06$, $p < .05$) and externalising behaviours ($sr^2 = .08$, $p < .05$) at age seven (Bohlin et al., 2012). The relationship between CU traits and disorganisation was significant after initial externalising behaviours and poor inhibition were entered first in the model (Bohlin et al., 2012). Interestingly, attachment insecurity – which included disorganisation as well as avoidant attachment styles – was not a significant predictor for either externalising behaviours or CU traits, suggesting that disorganised attachment, but not insecure or avoidant attachments, are related to CU traits.

Bohlin et al.'s (2012) study found that 11 children were classified as disorganised, although they did not use a dichotomous variable to divide CU traits into high vs. low categories, their demographic results suggest the sample had average to low levels of CU traits and externalising behaviours. Their mean for CU traits was 1.90 and the maximum recorded value was 3.70, in a sample with a range between 1 to 5. Most children scored below the mid-point of the scale, and the 3.70 value was a unique outlier (with a z-score indicating the score was 2.37 standard deviations above the mean). Similar scores are noted for the externalising behaviour subscales, indicating that even though some of the sample was considered "at risk", the overall sample can be characterised as having a mild to moderate

prevalence of behaviour problems. These demographic characteristics complement those of Pasalich's (2012) study, as that sample was recruited from a clinic treating behaviour problems; as a result, there was little variation in their measures of externalising psychopathology. Reassuringly, the relationship between attachment disorganisation and externalising disorders was present in this study, and yet there continued to be a significant association between disorganisation and CU traits.

These findings were subsequently replicated by a larger study which also found an association between attachment disorganisation and CU traits (Willoughby, Mills-Koonce, Gottfredson, & Wagner, 2014a; Willoughby, Mills-Koonce, Gottfredson, & Wagner, 2014b)[1]. Willoughby and colleagues (2014) used a large sample (n=1081) to test the association between CU traits, attachment typology, and later antisocial outcomes in a sample of 3-year-olds. This study used different measures of attachment disorganisation and CU traits than those discussed for previous studies: researchers used a modified version of the SSP for 3-year-olds, and measured CU traits with 5 items of the ASEBA (Achenbach System of Empirically Based Assessment-Preschool Forms) questionnaire, which had a relatively low Cronbach alpha of 0.55 (as compared to 0.75 for ADHD and 0.79 for ODD, all of which were measured with the ASEBA). Attachment disorganisation was coded as it had been in the previous studies, such that avoidant, ambivalent, and secure categories (n = 918) were compared to children falling under the disorganised category (n = 163) – see the erratum (Willoughby et al., 2014b). Lastly, aggression was measured every year between grades 1 to 6, and items pertaining to physical aggression to people and objects were grouped across these time-points to form a high/stable aggression dimension. Levels of CU, ADHD, and high/stable aggression were similar across both groups.

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[1] The original study by Willoughby et al. (2014a) showed no association between disorganisation and CU traits, but this was corrected in an erratum published later that year (2014b). The updated results are discussed here, which differ from the original results in several important ways.

Findings of this study are reported as two analyses: correlations among variables, and a set of logistic regression models predicting stable aggression in middle childhood. There was a small correlation between attachment disorganisation and CU traits ($r = .10$, $p < .05$). CU traits were associated with prospective aggression at five of the six points in time in which it was measured, and it was also significantly correlated with the high/stable aggression category ($r = .27$, $p < .05$). Disorganisation, which is known to be associated with externalising disorders (Fearon et al., 2010; Shaw, Owens, Giovannelli, & Winslow, 2001; van Ijzendoorn, Schuengel, & Bakermans-Kranenburg, 1999), was not strongly correlated to ODD, ADHD, aggression, income or maternal education. This is despite associations between disorganisation and impoverished backgrounds having been established in the literature (Bakermans-Kranenburg & van Ijzendoorn, 2009).

The second section compared three logistic regression models predicting membership in the high aggression category: a model including only demographic covariates, a model including all possible interactions, and a "trimmed" model in which some interactions were cherry-picked by virtue of showing stronger associations to the dependent variable (Willoughby et al., 2014a). In these models, gender, maternal education, race and CU traits were all significant predictors of membership in the high aggression category. The interaction between disorganisation and CU traits was not significantly associated with aggression. These findings are consistent with the correlations presented above. In brief, these results suggest that disorganisation is related to high CU traits, but only CU traits are significant predictors of stable/high aggression.

These findings are an important validation of previous studies as they replicate the association between disorganisation and CU traits even when using different measures of these constructs. However, the strength of the association was small ($r = .10$), warranting further consideration regarding why this was the case. Previous studies have expressed

concern about using the SSP in older children (Solomon & George, 2008), as it has failed to uncover behaviours otherwise associated with attachment dysregulation (Chisholm, 1998; Marcovitch et al., 1997). Indeed, this study failed to find an association between attachment disorganisation and almost all externalising categories (ODD, ADHD, aggression) and demographic variables associated with environmental adversity (maternal education, income), relationships that have been well-established in the literature. Likewise, the CU measure showed relatively poor reliability. As these measures may not have performed as expected, it is possible that measurement error was responsible for the weak association between disorganisation and attachment in this study.

In sum, all three studies testing an association between disorganised attachment and CU traits have found there to be a significant relationship between the two (Bohlin et al., 2012; Pasalich, Dadds, Hawes, et al., 2012; Willoughby et al., 2014a). Moreover, the well-established associations between these constructs and aggression suggest that models of CU traits and attachment disorganisation are parsimonious. This is not the case. Aetiological models for each construct posit different sources of influence, and the developmental timelines of these models are not well-aligned. Rather, these results suggest that the processes underlying attachment disorganisation models may be at play in emerging CU traits. This is an exciting and unexplored possibility that could reveal interpersonal developmental influences related to the emergence of CU traits. To explore this further, the next section focuses on the aetiology of attachment disorganisation during early childhood.[2]

Disorganised attachment

This section discusses attachment disorganisation models, which are remarkably different from the type of aetiological pathways normally associated with the development of

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[2] The thesis purposefully avoids discussing disorganisation in middle childhood (6 and above), which is characterised by either controlling-punitive or controlling-caregiving behaviours that the child directs to the parent. This topic was excluded as it is a feature of older age-groups.

CU traits. Rather than focusing on the child, these models focus either directly on the mother, or on dyadic aspects of the relationship. As discussed above, a failure to provide children with predictable, secure caregiving experiences confers risk for most behavioural and emotional problems (Bohlin et al., 2012; Fearon et al., 2010; Groh et al., 2012; Kim et al., 2014; Madigan et al., 2013). This is clearest in the "disorganisation" category (D), which has been associated with externalising disorders, impoverished backgrounds, and long-term adverse outcomes (Bakermans-Kranenburg & van Ijzendoorn, 2009; Fearon et al., 2010; van den Dries, Juffer, van Ijzendoorn, & Bakermans-Kranenburg, 2009). The "D" category was developed as researchers failed to classify certain infants into the other three categories and, being unable to group them in terms of other behaviours, they designated the overarching category as "disorganised". These were children who displayed bizarre characteristics under attachment threat, such as:

> "contradictory behaviour patterns; simultaneous displays of contradictory behaviour patterns; undirected, misdirected, incomplete, and interrupted movements and expressions; stereotypies, asymmetrical movements, mistimed movements, and anomalous postures; freezing, stilling, and slowed movements and expressions; direct indices of apprehension regarding the parent; and direct indices of disorganization" (Main & Solomon, 1990, p. 130).

These behaviours indicated a difficulty in forming a consistent and organised responses when faced with an attachment threat (e.g. separation). This lack of solution and fearful response when seeking comfort is central to disorganised infants (Lyons-Ruth & Jacobvitz, 2008). In order to examine the conditions leading to this behavioural presentation, a number of theoretical models have been developed. There are five main models explaining the development of disorganisation, four of which subscribe to a singular notion that some form of dysregulated parenting is responsible for dyadic disturbance (Lecannelier et al.,

2011). The last model does not challenge this assumption, but rather incorporates specific childhood vulnerabilities (Bernier & Meins, 2008). The assumption that parents drive dysfunctional attachments comes from robust meta-analytic findings showing that infant temperament determines a negligible proportion of the variance in attachment disorganisation (van Ijzendoorn et al., 1999). This has led some to conclude that findings indicate attachment disorganisation emerges within a particular relationship, and does not reside within inborn characteristics or traits of the infant (Lyons-Ruth & Jacobvitz, 2008).

Of the five models mentioned above, by far the most prominent is the original model by Main and Hesse (1990), which was introduced along with the conceptualisation for the disorganised category. Its premise is that parents, having suffered from previous psychological trauma, are unable to cope with the emotions elicited by their child, and therefore engage in frightened and frightening (FR) behaviours which disrupt the functioning of the dyad. The development of attachment disorganisation is associated with maltreatment and abuse perpetrated by a caregiver, indeed impoverished backgrounds show a much higher rate of disorganisation (24%) than that from middle-class families (14%; Lyons-Ruth & Jacobvitz, 2008). However, attachment disorganisation is also consistently found in low-risk samples, in which caregivers are unlikely to engage in abusive behaviours. Main and Hesse (1990) postulated that, in these low-risk cases, disorganised attachment arose due to a breakdown in the dyadic communication between caregiver and child. The breakdown occurred because caregivers were in a fragile state (caused by previous loss or trauma) and had difficulty processing emotions elicited by their infants, who exposed caregivers to intense displays of emotion (e.g. crying, fear) to which caregivers attended chaotically and maladaptively. The lack of adequate modelling and mirroring in turn led infants to become terrorised by the parent's responses. Main and Hesse write: "The traumatized adult's continuing state of fear together with its interactional/behavioural concomitants (frightened

and/or frightening behaviour) is the mechanism linking unresolved trauma to the infant's display of disorganised/disoriented behaviour." (p. 163; Main & Hesse, 1990). Traumatic experiences include sexual or physical abuse, but also experiences such as loss of a family member, which is considered potentially traumatic (Main & Hesse, 1990). According to Main and Hesse, parental unresolved trauma is expressed through frightening behaviours such as parents' unusual vocal patterns, movement patterns, and speech content – which induce fright in the child (Main & Hesse, 1990).

Main and Hesse also specify that the child's experience of fright might be too extreme to be deactivated by an attentional shift (as in avoidant attachment patterns), and cannot be ameliorated by proximity to the caregiver (as in secure or ambivalent/resistant patterns). The behaviours characteristic of disorganisation that arise in the child are therefore due to conflicting feelings, as the caregiver becomes simultaneously both a source of security and a cause for alarm. Since the publishing of Main and Hesse's work (1990) several studies have supported their initial findings; in a meta-analysis by Madigan and others (2006), parental frightened and frightening behaviours showed a moderate correlation with infant disorganisation (r=.32, N=234). Likewise, 53% of mothers of disorganised infants had unresolved responses to loss and trauma (van Ijzendoorn, 1995). These and other studies have established frightened and frightening behaviour by the parents as the main mechanism through which disorganised attachment is thought to be transmitted to the child in samples in which abuse was absent. Although these behaviours have been associated with disorganisation (Main & Hesse, 1990; Van Ijzendoorn et al., 1999) they alone do not account for the entirety of disorganisation cases – as seen in the example above where only about half of the mothers of disorganised infants showed unresolved responses to trauma (van Ijzendoorn, 1995). This has led to the development of four other models, capturing other parental behaviours also thought to be associated with disorganisation.

Lyons-Ruth, expanding on Main's work on parental behaviours, proposed that the caregiver's disrupted communication could also contribute towards a child's disorganisation (Lyons-Ruth, Bronfman, & Parsons, 1999). They postulated five dimensions of atypical maternal behaviours related to unmodulated infant fear: (1) role confusion – as when the mother requires the infant's reassurance after reunion; (2) negative intrusive behaviour – mocking, teasing; (3) disorientation – as noted in unusual vocal pitch and intonation; (4) withdrawal – silent interaction with the infant; and (5) affective communication error – as when the mother fails to respond to clear infant cues indicating appeals for proximity (Lyons-Ruth & Jacobvitz, 2008). These dimensions, as measured by the AMBIANCE – a model created by Lyons-Ruth and colleagues – were moderately related to both parental unresolved trauma (r=.20, N=311) and infant disorganisation (r=.35, N=384) in a large meta-analysis (Madigan et al., 2006). These sets of parentals behaviours, which could be termed jointly anomalous parental behaviours (Madigan et al., 2006) or disorganised caregiving (Solomon & George, 2011), significantly predicted infant disorganisation in samples without a history of abuse. Lastly, their model also broadened the types of trauma that parents were thought to have suffered, from loss and abandonment (as first suggested by Main & Hesse, 1990) to more general attachment issues in their own history (Lyons-Ruth & Spielman, 2004).

The last three models have not received the same level of empirical support as the first two, and expand on the work of previous models. A third model, by Solomon & George (1999), suggests that parental "failures to terminate the attachment interaction" (pp.14) are responsible for the development of disorganisation. That is, irrespective of the bizarre FR or AMBIANCE behaviours that the parent is displaying, the failure of the parent to regulate the infant's arousal could also lead to disorganisation – as the infant remains in a state of continuous arousal in which his/her attachment needs are not resolved. The fourth model, by Koós & Gergely (2001), focuses on a mismatch in responses (contingencies) that arise in the

interaction between parent and child, and which may lead the infant to direct undue attention towards itself, rather than the social world, as a source of emotional regulation. Lastly, Bernier & Meins (2008) threshold model holds that children's characteristics (such as their type of dopamine receptor), influence the ease with which they become disorganised; likewise, parental characteristics (such as their mental state, and their sensitivity) will determine how likely they are to engage in the types of behaviours mentioned in previous models. Bernier & Meins's (2008) study includes social and environmental stressors (teen pregnancy, substance abuse) as another factor influencing the likelihood of disorganisation in the dyad.

Since the model that has received the most attention is the original model by Main and Hesse, designating parental frightful and fright-inducing behaviours as causing disorganisation, other models are not necessarily seen as alternatives, but rather as complements to Main & Hesse's explanation. Paradoxically, they have all focused on parental behaviours, and all but one (Bernier & Meins's threshold model) somewhat ignore the child's contribution to the dyad. Madigan et al. (2006) found the relationship between anomalous parental behaviours and disorganised attachment to be significant but moderate, and the group encouraged researchers to look elsewhere for the unexplained variance between what they term "anomalous states of mind" (p.93) and attachment disorganisation. No studies have compared all of these different models, and few have assessed the incremental validity of adding other variables beyond Main and Hesse's fright-related behaviours (Madigan et al., 2006). In fact, recent research on attachment disorganisation has seen prominent researchers in the field call for "conceptual housekeeping" (p. 525; Duschinsky & Solomon, 2017) specificity with regards to both what is meant by disorganisation (Lyons-Ruth & Jacobvitz, 2016), and what interpretations can be drawn from a disorganised system.

In summary, the attachment system is important for a healthy socio-emotional development (Bretherton & Munholland, 2008; Rutter & Sroufe, 2000; Stams, Juffer, & van Ijzendoorn, 2002). Dysregulation of the attachment system can take many forms, with a "disorganised" system being most strongly associated with externalising psychopathologies (Fearon et al., 2010; Groh et al., 2012). Infants showing a disorganised response may show a wide variety of behaviours (e.g. contradictory behaviours, freezing, aggression, etc.) (Main & Solomon, 1990), which are thought to be elicited by either severe maltreatment in high-risk families or, in low-risk families, by failures in maternal reactions to the child – notably maternal FR behaviours – but possibly including a lack of appropriate responses to the child's internal state (e.g. affective communication errors, harsh parenting, lack of arousal-regulation). The section below explores how this narrative creates areas of tension with current aetiological accounts of CU traits.

Areas of tension: Models of disorganised attachment versus models of high CU traits

There are three areas of tensions between aetiological narratives of attachment disorganisation and CU traits to be discussed in this section before focusing on how best to explore these empirically. The first concerns the role of fear in these two models. Children with CU traits have an insensitivity to fear from an early age, yet *reactivity to* fear is meant to drive disorganisation. The second is the role of maltreatment in the aetiology of these disorders, where maltreatment is thought to be highly associated with attachment disorganisation, but less so with CU traits, where maltreatment is more likely to be associated with a subtype of children with elevated levels of comorbid anxiety. Third is the influence of the parent as a driver of dysfunction in the interpersonal relationships – a position supported by attachment disorganisation models focusing on aberrant parental behaviours, but much less clear in the aetiology of CU traits, where parenting is less effective at changing behaviours and the child's pathology (or traits) are central to the CU construct. These three

areas of tension represent an overarching trend in the CU literature placing most of the aetiological burden on the child, and a converse trend in the attachment literature placing most of the aetiological burden on the parent.

The role of fear. Elevated levels of CU traits have been associated with a failure to recognise fear across a range of stimuli, including facial expressions (Dadds et al., 2006; Dawel, O'Kearney, McKone, & Palermo, 2012), bodily postures (Muñoz, 2009), and in speech samples (Blair, Budhani, Colledge, & Scott, 2005; Dadds et al., 2011). It has also been suggested that although this effect is strongest for fear, it can be generalised to all emotions (Dawel et al., 2012). Deficits in the recognition of fear are particularly robust in face-recognition paradigms, in which children high on CU and conduct problems are less accurate than those with low CU but high conduct problems (Dadds, El Masry, Wimalaweera, & Guastella, 2008). This effect is driven, at least in part, by deficits in eye-gaze such that children with CU traits look more at the mouth region than the eyes (Dadds et al., 2008; Muñoz, 2009). Interestingly, the fear-recognition deficit can be rescued by instructing the children to focus on the eyes, which suggests deficits in attention to the eyes as salient social stimuli. These findings suggest a generalised deficit in attending to emotional cues which may impair children's understanding of emotions, particularly so for negative emotional stimuli (Kimonis, Frick, Fazekas, & Loney, 2006; Loney, Frick, Clements, Ellis, & Kerlin, 2003).

This insensitivity to fear is problematic in the context of the development of a disorganised attachment, in which facial expressions by the parent are distressing for the infant. For example Main & Hesse, who developed the fear-driven hypothesis (Main & Hesse, 1990), posited that fearful behaviours in parents were driven by parental fright (Hesse & Main, 2006). They mentioned that parental fright is sufficient, but not necessary, to evoke disorganisation, particularly in low-risk samples that are unlikely to have suffered abuse

(Hesse & Main, 2006). The table below summarises the main parental behaviours associated

with fear (Hesse & Main, 2006):

Table 1. Main categories for coding parental frightened and frightening behaviours (from Hesse & Main, 2006).

Major or Primary Aspects of Frightening Parental Behavior Expected to Directly Evoke Infant Alarm
1. *Direct indices of entrance into a dissociative state*: for example, parent suddenly completely "freezes" with eyes unmoving, half-lidded, despite nearby movement; parent addresses infant in an "altered" tone with simultaneous voicing and devoicing ("haunted" sound, as can be produced by elongating the sounds of "*Hi*," "*huh*," or "*ah*" while pulling in on diaphragm)
2. *Threatening behavior inexplicable in origin and/or anomalous in form*: for example, in nonplay contexts and in the absence of metasignals of play, stiff-legged "stalking" of infant on all fours, exposure of canine tooth, hissing or deep growls directed at infant
3. *Frightened behavior patterns inexplicable in origin and/or anomalous in form*: sudden frightened look (fear mouth, exposure of whites of eyes) in absence of environmental change; also frightened retreat from the infant or approaching infant apprehensively as though a potentially dangerous object

As seen in the table above, frightened behaviours explicitly include the kind of stimuli

that children with CU traits are least sensitive to: "sudden frightened look (fear mouth,

exposure of white of eyes)". In support of this, several studies using similar coding schemes

have found that frightening and frightened maternal behaviours are indeed associated with a

disorganised attachment (Lyons-Ruth et al., 1999; Schuengel, Bakermans-Kranenburg, &

Van Ijzendoorn, 1999). This raises interesting possibilities. It may be the case that infants

displaying disorganisation are not traumatised by their mothers throughout their interactions,

but rather that their behaviour manifests a shared genetic risk associated with emotion-

processing deficits. Alternatively, it could be the case that infants high on CU traits have been

deeply impacted by their mothers' behaviours, and that this dyadic disturbance plays a role in

their later deficits in fear-recognition and empathy-development. Having established these

two arguments in opposition, the nuances between these narratives are briefly discussed below.

Recent research has established that infants with a disorganised attachment show emotion-recognition deficits similar to those of children with elevated levels of CU traits (Forslund, Kenward, Granqvist, Gredebäck, & Brocki, 2017; Peltola, Forssman, Puura, van Ijzendoorn, & Leppänen, 2015), including more pronounced effects for fear (Peltola et al., 2015). It is unclear whether these deficits themselves are predictive of the development of CU behaviours, although disorganisation has itself been linked with deficits in the recognition of internal emotions and those of others (Beebe et al., 2010). These shared features between children with a disorganised attachment and those with elevated levels of CU traits suggest there may be similarities, such as shared genetic risk, underlying these typologies. While the role of fear is central to the construct of attachment disorganisation, it is not the only mechanism leading to a disorganised attachment system.

Importantly, even though frightening/frightened behaviours are enough to successfully discriminate disorganised vs. organised groups, the strongest associations between parental behaviours and infant disorganisation are found when using all dimensions of the AMBIENCE model (Lyons-Ruth et al., 1999). For example, in a detailed micro-analysis of interactions between mothers and infants, behaviours such as threatening "looming" head movements, gazing away from the infant, or lack of synchrony in the dyads' communication, were the most likely to distinguish between disorganised and secure mother-infant dyads (Beebe et al., 2010; Beebe et al., 2012; Beebe & Steele, 2013). In fact, some authors argue that the presence of fear may designate a specific sub-group of disorganised infants (Padrón, Carlson, & Sroufe, 2014), possibly one characterised by environmental (i.e. maltreatment) rather than congenital (i.e. neurological) risk (Duschinsky & Solomon, 2017).

Likewise, a range of parental variables have been associated with the development of CU traits, including parental warmth (Hawes & Dadds, 2005; Pardini et al., 2007; Pasalich, Dadds, Hawes, & Brennan, 2011a; Pasalich, Dadds, Vincent, et al., 2012) and parental sensitivity (Bedford, Pickles, Sharp, Wright, & Hill, 2015; Bedford et al., 2017; Centifanti, Meins, & Fernyhough, 2015; Wagner, Mills-Koonce, Willoughby, & Cox, 2017; Wagner et al., 2015). These shared risk factors suggest there are other parental behaviours (beyond fear) which may be shared by both disorganised and high CU infants. Therefore, it may be fruitful to include parental behaviours associated with disorganisation when examining the aetiology of CU traits, as it may uncover new pathways associated with the emergence of CU behaviours.

   The role of maltreatment. Maltreatment, CU traits, and attachment disorganisation are all significant independent predictors of aggression and psychopathology (Gilbert et al., 2009; Heim, Shugart, Craighead, & Nemeroff, 2010). Attachment disorganisation and high CU traits could also be considered multi-final outcomes derived from a history of maltreatment. However, like fear, the impact of maltreatment is understood differently in each field: in attachment disorganisation maltreatment is thought to precipitate cognitive dysregulation in the infant (i.e. chaotic or contradictory thoughts) leading to aberrant behaviours (Duschinsky & Solomon, 2017; Main & Solomon, 1990); in contrast, the role of maltreatment is less clear in the literature on CU traits (Kimonis, Fanti, Isoma, & Donoghue, 2013), where maltreatment is thought to interact with pre-existing biological risk (i.e. diathesis-stress model) differently for CU sub-groups (Cecil et al., 2014). The tension between these accounts resides in two related points: the role of maltreatment in aetiology, and the timing of maltreatment – when maltreatment is at its most harmful. As above, the argument presented here is that comparing these narratives on maltreatment might generate new hypotheses for each literature.

Maltreatment is considered a sufficient, but not necessary, condition leading to disorganisation of the attachment system (Carlson, Cicchetti, Barnett, & Braunwald, 1989; Cyr, Euser, Bakermans-Kranenburg, & Van Ijzendoorn, 2010), as maltreatment is likely to elicit fright from the infant, as well as competing needs to approach and escape the caregiver. In a meta-analysis of research on maltreatment and attachment disorganisation, children exposed to maltreatment were significantly more likely to be categorised as disorganised than those who had not been maltreated. The large effect size ($d = 2.10$) indicated maltreated children were more than two standard deviations more likely to be categorised as disorganised rather than securely attached (Cyr et al., 2010). These strong effects mirror previous findings, indicating that as many as 90% of maltreated samples have been categorised as disorganised (Cicchetti, Rogosch, & Toth, 2006). Yet little is known about which types of maltreatment are more likely to result in disorganisation: for example, the meta-analysis by Cyr and colleagues (2010), in an explorative analysis, found similar effects for physical abuse relative to neglect. This maltreatment is thought to occur within the first five years of life, but particularly before the first year of life, when the strange situation procedure (SSP) is traditionally assessed.

The role of maltreatment in CU aetiology is much less clear, as it varies depending on the type of abuse suffered. There is a positive association between CU traits and maltreatment (Dackis, Rogosch, & Cicchetti, 2015; Kimonis, Cross, Howard, & Donoghue, 2013; Kimonis, Fanti, et al., 2013; Kimonis, Frick, Munoz, & Aucoin, 2008), however this seems to be driven by a sub-group of CU children who had experienced abuse associated with greater emotional lability, such as physical abuse or sexual abuse (Dadds, Kimonis, Schollar-Root, Moul, & Hawes, 2017; Kimonis, Fanti, et al., 2013). In contrast, maltreatment characterised by neglect may be more strongly associated to a lack of concern with others' emotions (Kimonis, Fanti, et al., 2013). The sub-group of children with high levels of CU traits and

comorbid anxiety is considered a "secondary variant" of CU traits; distinguishable from the "primary variant" or "pure CU", in which case CU traits tends to be negatively associated with anxiety (Hicks, Markon, Patrick, Krueger, & Newman, 2004; Kimonis, Fanti, et al., 2013; Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012a; Kimonis, Frick, Munoz, et al., 2008; Pardini et al., 2007). Distinguishing between high CU groups based on their maltreatment profile and anxiety comorbidity has been useful for researchers focusing on emotion recognition and autonomic arousal (Dackis et al., 2015; Dadds et al., 2017; Kimonis et al., 2012a), who have found that samples with a history of maltreatment tend to lack the deficits (in arousal and emotion recognition) normally associated with high CU traits. It has recently been suggested that these variants have different aetiological pathways for the development of CU behaviours (Cecil et al., 2014).

The best evidence for these dual pathways comes from Cecil and colleagues (2014), who conducted a 13-year longitudinal study collecting antenatal and biological data. Participants belonging to the emotionally dysregulated subcategory or "secondary variant" (operationalised by the presence of internalising symptoms) were more likely to face high-risk environments (consisting of life events, contextual risks, parental risks, interpersonal risks, and direct victimisation) in the first seven years of life; and this category was associated with oxytocin (OXT) methylation at age seven. Instead, classification in the pure CU category was associated with prenatal influences. This group was strongly associated with prenatal parental risks (which included parental psychopathology, criminal involvement, and substance use), and OXT methylation at birth, rather than at age seven. The pure CU group presented with comparable levels of environmental risk prenatally and in middle-childhood, but lower overall levels of environmental risk (particularly direct victimisation) during early childhood (birth to age 7). These characteristics suggest that pure CU categories are influenced by events occurring before birth, while dysregulated CU presentations are more

likely to be associated with risk during the first seven years of life (Cecil et al., 2014).
Therefore, post-natal risk in the form of maltreatment might be a necessary but insufficient
condition for the development of emotionally dysregulated CU traits; whereas pre-natal
maltreatment might be neither necessary nor sufficient for the development of pure CU.
Below, the exploration of time-dependent analysis is applied to the attachment context.

The attachment disorganisation literature has tended to move away from maltreatment
typologies (neglect vs. physical abuse), focusing instead on patterns of observable behaviours
(Beebe & Steele, 2013; Lyons-Ruth & Jacobvitz, 2008); however, there has been little
success at placing these behaviours within specific temporal contexts. In contrast, the model
specified above for the CU literature suggests there may be important sensitive periods for
affective parent-child interactions, though it remains vague regarding which parental
behaviours and states of mind may be associated with the emergence of CU traits. By
combining these two literatures there is a potential for substantial benefit, as analyses
investigating sensitive periods in the development of affect – including variables associated
with both CU traits and attachment disorganisation – might place parental influences within a
temporal context that may be particularly relevant for understanding gene x environment
interactions (Cecil et al., 2014). A higher temporal specificity would also help to explain the
process through which individuals internalise dyadic features (e.g. attachment system) into
personal and relatively stable patterns of responding to an attachment figure, through internal
working models (Bretherton & Munholland, 2008). It may be useful for the CU literature to
incorporate this process of internalisation as a way of understanding both the modelling and
the dysregulating effects associated with maltreatment.

The role of the child. The aetiological burden placed on the child differs greatly
between the CU and attachment literature; with attachment disorganisation placing most of its
emphasis on the parent (Main & Hesse, 1990), and CU traits placing most of the burden on

the child (Viding, Fontaine, Oliver, & Plomin, 2009; Viding, Jones, Frick, Moffitt, & Plomin, 2008). In attachment disorganisation, children's characteristics were mostly construed as temperament, and when temperament showed robust non-significant associations ($r = .0008$) with disorganisation (van Ijzendoorn et al., 1999), efforts to quantify children's contributions to their attachment classification diminished. Other ways to acknowledge children's influence have included behavioural and genetic studies. Behavioural studies looking at micro-analyses of social interactions in disorganised vs. secure infants conclude that (Beebe et al., 2010):

> "(…) there is no general maternal confusion, no overall failure of empathy, or failure to register or read infant states. (…) Instead, many difficulties of mothers of future D infants occur at specific heightened moments of contradictory behaviour patterns, triggered at moments of infant distress." (p. 66, Beebe et al., 2010).

Indeed, while Beebe and colleagues (2010) found disorganised infants were more likely to express distress, and tended to do so somewhat chaotically (e.g. discordant facial vs. vocal affect) and with fewer regulation strategies (e.g. disorganised infants were more likely to remain untouched by their mothers), mothers of disorganised infants showed more dramatic differences. For example, they spent less time looking at their infant's face, but were more likely to threateningly "loom" over the infant, while they were simultaneously more likely to express positive emotions when reacting to the child's distress, and to display flat facial expressions (e.g. overly stable face). While acknowledging the infant is not a passive agent, these behavioural influences ultimately suggest that it is the caregiver's reactions to the infant that are responsible for the subsequent disorganisation exhibited by the infant. Genetic studies of attachment have tended to corroborate this narrative, with few consistent genetic effects associated with security or disorganisation (Gervai, 2009; Luijk et al., 2011; Spangler, Johann, Ronai, & Zimmermann, 2009), and Spangler and colleagues

(2009) conclude that "so far, a final conclusion about the contribution of specific genetic differences on the development of attachment disorganisation cannot yet be drawn" (p.953; Spangler et al., 2009). Consistent with this, twin studies have found negligible evidence of genetic contributions to either attachment security or maternal sensitivity in children (Fearon et al., 2006; O'Connor & Croft, 2001), although by adolescence genetic contributions to attachment range between 35-37% (Fearon, Shmueli-Goetz, Viding, Fonagy, & Plomin, 2014). The failure to find strong child-driven effects in disorganisation is paralleled by evidence showing strong maternal contributions to attachment via parental sensitivity or maltreatment – as discussed previously.

In contrast, the literature on CU traits has tended to place most of the burden on the child, as the genetic component of attachment has tended to outweigh shared and non-shared environmental effects (Viding et al., 2009; Viding et al., 2008). Twin studies have revealed large estimates (~42%) on the amount of variance in CU traits accounted for by genetic effects (Larson, Andershed, & Lichtenstein, 2006; Taylor et al., 2003). Another large set of studies (n= 3,687 twin pairs) by Viding and colleagues (2005; in press) revealed several important findings. For example, they estimated the heritability of conduct problems separately for children with high and low CU traits, and found that those high on CU traits had a heritability rating of .81, substantially larger than the .30 found in pairs with low CU traits. These studies also found that the influence of the shared environment was very low for those high in CU traits, but high for those with low levels of CU traits, indicating that factors that were shared by the twin dyad, such as parenting, did not adequately explain variance in conduct problems. Consistent with this idea, studies have shown that parenting interventions are less effective when aimed at children with high CU traits (Hawes & Dadds, 2005). This evidence suggests the emergence of CU traits cannot be solely explained by investigating parenting behaviours.

Studies focusing on infants' characteristics have investigated the timing in which physiological responses diverge between CU and non-CU samples. These studies have uncovered differences in hormonal, autonomic, and behavioural responses of young infants that are associated with the later development of CU behaviours. For example, Mills-Koonce et al. (2015) used a large sample of 1,292 children which had measures of autonomic arousal such as respiratory sinus arrhythmia (RSA) and heart-rate period (HP), salivary cortisol, and fear reactivity at 6 and 15 months of age to predict CP + CU traits at ages 5-7. They found that children with CP + CU were no different from children with CP only or neither CP or CU at 6 months of age; however, at 15-months of age these children seemed to be hyperreactive to stressors. That is, they displayed lowered basal activity (generally associated with resting states), higher salivary cortisol, and heightened fear responses in response to a fright-inducing task (Mills-Koonce et al., 2015). These findings have been extended by showing that changes in RSA, but not HP, are associated with CU specifically, rather than the combination of CU + CP (Wagner, Mills-Koonce, Willoughby, Propper, et al., 2017). These findings are consistent with similar results in adolescents, showing lower RSA, but not HP (de Wied, van Boxtel, Matthys, & Meeus, 2012). This suggests a hyperreactive profile, particularly in the parasympathetic nervous system, that is inconsistent with the hypo-reactivity characteristic of CU in adulthood.

Other studies linking children's characteristics to later CU traits have found that they tend to be behaviourally less responsive than their non-CU peers. A study with 206 6-month infants, in which these infants completed the still-face procedure (FFSFP), found that infants who were less responsive to their mothers were more likely to develop CU/ODD behaviours (Wagner et al., 2016). More specifically, infants less likely to look at their mothers during face-to-face time, and who were less reactive during the still-face episode, were more likely to present with antisocial behaviours later in life. Similarly, a study with 213 participants

found that lower preferential face-tracking as early as 5 weeks of age predicted higher CU traits at 2.5 years (Bedford et al., 2015). Studies with older children have found deficits in early childhood (ages 3 and 4) that are similar to those reported later in childhood (between 5 – 12). For example, young children (aged 3) who were rated by their parents as showing less concern were worse at recognising fearful expressions (White et al., 2016). In a different study investigating emotion understanding deficits at age 4 (as measured by a combination of recognising emotions and understanding how emotions are employed, caused, and modified), a lower ability to understand emotions was associated with the later development of CU behaviours at age 10 (Centifanti et al., 2015). And yet, as Centifanti's (2015) study demonstrates, it has been increasingly evident that parenting also plays an important role in explaining the emergence of CU traits.

Maternal sensitivity and parental warmth have been associated to the later development of CU traits in a number of research studies (Bedford et al., 2015; Bedford et al., 2017; Centifanti et al., 2015; Kochanska et al., 2013; Wagner, Mills-Koonce, Willoughby, & Cox, 2017; Wagner et al., 2015; Waller et al., 2015; Waller et al., 2014; Waller & Hyde, 2017b). The role of maternal sensitivity in the emergence of CU traits is a relatively recent area of research which has shown promising results. For example, in Centifanti and colleagues' (2015) study, in which emotion understanding deficits were associated with the later development of CU behaviours, emotion understanding at age 4 was itself predicted by maternal sensitivity and maternal mind-related talk to the child at 8 months of age. Similarly, higher maternal sensitivity when infants were 5-weeks of age was associated with lower CU traits when children were 2.5 years, in girls but not boys (Bedford et al., 2015). In another large longitudinal study, that uses the Family Life Project sample (1,292 participants), Wagner and colleagues (2017) measured maternal sensitivity, harsh intrusions, maternal mental state talk, and cortisol reactivity at 6- and 15-months, and tested

longitudinal associations with CU behaviours, conduct problems (CP), and empathic-prosocial ratings at age 7. Maternal sensitivity was judged based on the mother's responsiveness and support offered to the child relative to the child's needs, as coded from behavioural observations of mother-child interactions. They found that their measure of maternal sensitivity significantly predicted all three outcome variables: CP, CU, and empathic-prosocial ratings (Wagner, Mills-Koonce, Willoughby, & Cox, 2017). In a different longitudinal study investigating the interaction of maternal sensitivity and infant gaze, 206 families were assessed at 6-months, 6 years and 7 years of age (Bedford et al., 2017). Here, it was found that for mothers exhibiting low maternal sensitivity, low infant gaze (fewer instances in which the child was looking at the mother) during the still-face procedure was associated with CU behaviours at age 7, but this was not the case if mothers exhibited an average or high degree of sensitivity (Bedford et al., 2017). That is, either maternal sensitivity early in life exerted a protective effect over risk variables (low-infant gaze) associated with CU traits, or a lack of maternal sensitivity allowed infant-gaze to determine the trajectory of the parent-child relationship, facilitating the emergence of CU traits.

Likewise, research on CU traits has found that although this group of children is less responsive to punishment strategies or harsh parenting (Hawes & Dadds, 2005), these children are responsive to parental warmth (Pardini et al., 2007; Pasalich et al., 2011a; Pasalich, Dadds, Vincent, et al., 2012). For example, Pardini and colleagues (2007) found that child-reported warmth was predictive of higher levels of CU traits and antisocial behaviour longitudinally in a sample of highly aggressive 9- to 12-year-old children. Building on these results, Pasalich and colleagues (2011) investigated warmth, coded from 5-minute speech-samples, in a sample of children referred to a clinic for conduct problems. They found that, in mothers, harsh and coercive parenting was related to conduct problems only in children with low CU traits, while warmth was associated with conduct problems only in

children with high CU traits. These results were replicated in fathers, although they did not reach statistical significance (Pasalich et al., 2011). More recent studies have confirmed that children with high CU traits are more susceptible to parental warmth than was previously assumed. Notably, a longitudinal study of 561 adopted children along with their adoptive and biological parents, found that while biological mothers' self-reported fearlessness and low affiliative behaviours were linked to their children's CU behaviours at 27 months, high levels of adoptive mothers' positive parenting reduced the likelihood the child would display CU behaviours (Waller et al., 2016). Arguably, their measure did not capture warmth explicitly, but it did raise the possibility that warmth, or lack of warmth, is associated with CU traits.

These two variables, warmth and parental sensitivity, are especially interesting in the context of attachment, as these are the kind of parental behaviours associated with attachment disorganisation (Lyons-Ruth & Jacobvitz, 2008). The role of the parent, then, can be said to be central to both disorganisation and attachment. However, the same is not clear for the role of the child. Especially as differences in genetic contributions to attachment (Fearon et al., 2006; O'Connor & Croft, 2001) and CU traits (Viding et al., 2009; Viding et al., 2008) suggest that the genetic contributions for the CU population are different than those for attachment disorganisation. This raises intriguing possibilities. Namely, that in groups with high CU traits, affective dysregulation and attachment disorganisation are driven by child characteristics. Alternatively, it may be that groups with high levels of CU traits, who are surveyed early in development, share similar features with groups characterised by attachment disorganisation, such as dysregulated parenting.

Summary. This section addressed the roles of fear, maltreatment, and the child's centrality. First, fearful/frightening behaviours are a central mechanism in the transmission of attachment disorganisation, but it is unclear how these operate in the context of children characterised by a fearless temperament. Second, it is unclear how specific negative parental

responses associated with maltreatment are associated with CU emergence, although there is evidence to suggest these may be time-dependent; in contrast, the attachment literature has focused on very specific parenting behaviours that largely lack temporal specificity. Third, the CU literature places the aetiological burden on the child, whereas attachment places it on the parent. This intersection allows for the investigation of affective dysregulation in a population characterised by trait-driven interpersonal problems.

Overview of the present research

The above review showed that children with high CU traits show high rates of disorganised attachment. It also showed that the main theoretical and empirical accounts of the aetiology of disorganised attachment are largely incompatible with our current understanding of the characteristics and development of children with high CU traits. This thesis thus seeks to investigate the tensions between attachment disturbance and emergent CU traits. More specifically, the thesis investigates the roles of fear, temporal specificity of parenting dysregulation, and the centrality of the children's own affective dysregulation by employing the language and mechanisms of attachment to investigate the emergence of CU traits in clinical and community samples. This was done to uncover precise interactions between specific attachment processes and individual differences in CU psychopathology.

To achieve this, the research focused on testing specific hypotheses from the attachment literature as potential mechanisms associated with the emergence of CU traits. First, by examining the intergenerational transmission of CU traits, from parental psychopathy to children's CU traits. Second, by developing specific tools to test associations uncovered in Study 1, between parental and children's affective dysregulation. Third, tools assessing parents' state of mind and feelings towards the child were compared to those measuring the child's affective behaviours in the prediction of emerging CU traits. Fourth,

these tools were used in a longitudinal analysis to test whether associations uncovered in Study 3 were measure-invariant and could be successfully detected during infancy. The aims and hypotheses for each of the studies is described in further detail below.

Overall aim and research questions.

The aim of the first study was to investigate intergenerational stability between parental psychopathy and children's CU traits. To do this, associations between psychopathy scores in parents and levels of CU traits in children were compared for families attending a clinic for child behaviour problems. This study tested three main hypotheses. First, whether the presence of psychopathic features in parents conferred a general risk for their children's development of CU traits. Second, whether parental psychopathy conferred specific risk for child CU traits, and was not merely an index of general risk. That is, there was an expectation that parent's psychopathy scores would explain a significant amount of the variance in children's CU trait scores over and above the three general risk factors mentioned above (parental psychopathology, warmth, and harsh parenting behaviours). Given previous findings it was expected that this relationship would be strongest for parents' psychopathy factor 1, and more so for fathers relative to mothers. Third, it was expected that these pathways would vary by gender, as the literature suggests these groups differ in their aetiological pathways (Fontaine et al., 2010; Silverthorn & Frick, 1999). It was expected that the strongest associations would be between fathers' psychopathy factor 1 and boys' CU traits.

The second study focused on the development of new tools to test whether maternal warmth moderated the association between parental psychopathy and child CU traits. These tools were created based on the literature on attachment and CU traits described above, and

were called: The Interview on Critical Bonding Moments (ICBM) and the Child Affective Behaviours (CAB) scale. In this study separate analyses were conducted testing the internal structure, temporal reliability, inter-rater agreement, criterion validity and longitudinal stability of the measures.

The aim of the third study was to test parent and child contributions to the CU aetiology using a mixed sample of clinical and community cases. More specifically, it was hypothesised that parental fright and self-reported bonding would be associated with CU emergence, as assessed by the ICBM. There was a second competing hypothesis suggesting that the child's own affective characteristics, as described by the CAB, would also be associated with CU traits in the children. Moreover, it was expected that the relationship between children's affect and emerging CU behaviours would be stronger than equivalent relationships with parenting variables.

The fourth study aimed to confirm that the relationships uncovered in previous studies could be replicated longitudinally when the same constructs were measured using different tools. This study was carried out in a small sample of 49 pre-schoolers who were assessed during pregnancy, at 3 months after childbirth, 1 year after childbirth, and 4 years after childbirth. It was hypothesised that: (1) cross-sectional relationships uncovered in the third study between parental (fright and disinterest) and child (affect) characteristics and CU traits would be replicated at age 4; (2) that the constructs assessed by these measures (fright, disinterest, and affect) could be assessed earlier in development (< 4 years); (3) that earlier assessments of these constructs would continue to predict CU traits at age 4.

These results are then discussed in greater depth, allowing for speculation on the significance of these results for the aetiology of CU traits. The implication of results for other

areas of the CU literature are also explored, as well as a discussion of the study's strengths and limitations.

STUDY 1: INTERGENERATIONAL TRANSMISSION OF CALLOUS AND UNEMOTIONAL TRAITS

This study set out to establish whether psychopathy traits in parents were associated with emerging CU traits in children by conferring specific risk for CU traits, over and above other risk variables associated with CU development: warmth, parental psychopathology, and negative parenting practices. Warmth, in particular, had been suggested by recent studies as a central parenting variable for the development of CU traits (Hyde et al., 2016; Waller, Gardner, & Hyde, 2013b), a finding confirmed by studies of similar design (Loney et al., 2007), which found warmth to mediate the association between psychopathic traits in parents and CU traits in children. Examining this association allowed us to enquire whether parenting in general, and warmth in particular, continued to be relevant for CU aetiology even when accounting for the influence of parental psychopathy, a proximal source of influence.

Additionally, a number of methodological issues regarding previous studies led to specific hypotheses. First, the use of gender-specific samples (Auty et al., 2015; Loney et al., 2007) or gender-biased samples (Kahn et al., 2016) – curtails our ability to draw gender-based inferences, which may be important in understanding the role of mediating factors. For example, Auty et al. (2015) found differences depending on the gender of the children of psychopathic parents. Some studies have found females are less likely to express CU traits (Essau et al., 2006; Fontaine et al., 2010), and males have a stronger association between genetic influences and CU traits (Fontaine et al., 2010). Silverthorn & Frick (1999) argue that females might have a delayed onset of antisocial behaviors due, in part, to a higher susceptibility to environmental (family) dysfunction (1999). Research investigating the relationship between eye-gaze deficits, fear recognition, and CU traits, found that fathers, but not mothers, showed a similar impairment to their high CU children (Dadds et al., 2011). It is also likely that family interactions are influenced by gender, as shown previously by

Fredricks & Eccles's (2004) study on sport motivation, and McHale and colleagues regarding gender development (2003). Altogether, these differences suggest it is important to test for different pathways in male and female participants when seeking to understand the role of parental psychopathy in the development of CU traits.

Second, although the studies mentioned above applied mediation analyses (Hyde et al., 2016; Kahn et al., 2016; Loney et al., 2007), the variables included were not theoretically exhaustive, and captured only certain aspects of psychosocial risk (e.g. parenting dysfunction or drug use), while excluding others (e.g. warmth or mental health) known to be of interest. Warmth in particular appears to be important in the maintenance and development of CU traits (Elizur et al., 2017; Kochanska et al., 2013; Pasalich et al., 2011b; Pasalich, Dadds, Vincent, et al., 2012; Waller et al., 2013a; Waller et al., 2017). Maladaptive parenting practices or parental mental health, both of which are associated with the development of negative mental health outcomes, were not assessed in all studies assessing intergenerational stability of CU traits (Cummings et al., 2005; Pettit et al., 1997; Prinz et al., 2009).

The aim of this study was to investigate intergenerational stability between parental psychopathy and children's CU traits – identifying whether there is a role for parenting in CU aetiology. To do this, associations between psychopathy scores in parents and levels of CU traits in children were examined for families attending a clinic for child behavior problems. This study tested three main hypotheses. First, that the presence of psychopathic features in parents conferred a general risk for their children's development of CU traits. Second, that parental psychopathy would confer specific risk for child CU traits, and would not merely index general risk. That is, it was expected that parents' psychopathy scores would explain a significant amount of the variance in children's CU trait scores, over and above the three general risk factors mentioned above (parental psychopathology, warmth, and harsh parenting behaviors). Given previous findings it was expected that this relationship would be strongest

for parents' psychopathy factor 1, and more so for fathers relative to mothers. Third, these pathways were hypothesised to vary by gender, as the literature suggests these groups differ in their etiological pathways (Fontaine et al., 2010; Silverthorn & Frick, 1999). In general, the strongest associations expected would be between fathers' psychopathy factor 1 and boys' CU traits.

Methods

Participants

The main inclusion criterion was referral to the Child Behavior Research Clinic at the University of New South Wales or Royal Far West child health center (Sydney, Australia), for disruptive behavior disorders. The CBRC specialises in the treatment of disruptive behavior disorders associated with a DSM-IV diagnosis of oppositional defiant disorder, conduct disorder, ADHD, or autism spectrum disorder (ASD) through parent-management training. All participating children were assessed using DSM-IV criteria (Association., 2000), and children with significant ASD symptoms or children with a major neurological/physical illness or a developmental disability were excluded from the study. The clinical profile includes the following primary diagnoses: 42.0% (41.3% in boys, 42.7% in girls) conduct problems (oppositional-defiant disorder and/or conduct disorder), 19.5% ADHD (20.6% in boys and 18.3% in girls), and 2.2% anxiety or depression (3.2% in boys and 1.2% in girls), with the rest of the participants meeting partial but not full diagnoses. Additionally, another 15.1% of the sample had a secondary diagnosis of conduct problems (15.6% for boys and 14.6% for girls). The final sample had a total size of 306 children (223 boys, 83 girls), with an age range of 3-15yrs, and a mean age of $M = 7.65$ (SD = 2.912) for boys and $M = 7.35$ (SD = 3.202) for girls. Self-report questionnaires were collected from participating families (300 maternal responses; 226 paternal responses).

Measures

All measures were collected prior to the family's commencement of treatment. Note that all scores were standardised for the third and fourth parts of the analysis, as described in the analytic plan below.

Parental psychopathic traits were measured using Levenson's Self-Report Psychopathy Scale (LSRP), a 26-item measure scored on a 4-point scale ranging from "Disagree Strongly" to "Agree Strongly" (Levenson, Kiehl, & Fitzpatrick, 1995). Example items include: "I feel bad if my words or actions cause someone else to feel emotional pain" and "Love is overrated". This measure, meant for use in non-criminal populations, can be divided into psychopathy factors 1 and 2, the first scale consists of 16 items and the second of 10. Items 3, 9, 12, 14, 15, 19, and 22 were reversed scored and the mean score was calculated for each subscale. Cronbach's alpha for the general scale in mothers was .85 (.82 for the factor 1 subscale and .65 for the factor 2 subscale); in fathers, the general scale had a reliability of .84 (.83 for the factor 1 subscale and .67 for the factor 2 subscale).

Parenting behaviors were measured using the short form of the Alabama Parenting Questionnaire, a 15-item questionnaire on a five-point endorsement scale ranging from "Never" to "Always" (Scott, Briskman, & Dadds, 2011; Shelton, Frick, & Wootton, 1996). An example item is: "You threaten to punish your child and then do not actually punish him/her". The APQ has five-subscales: positive parenting, inconsistent discipline, parental supervision, parental involvement, and corporal punishment. Items from positive scales were reversed and all four scales were summed to form a general "negative parenting" factor, a procedure followed in similar studies (Loney et al., 2007). The final scale was therefore composed of fifteen items, and had a reliability of .72 for mothers and .72 for fathers.

Parental psychopathology was assessed using the Brief Symptom Inventory (Derogatis & Melisaratos, 1983), a 53-item measure assessing three global indices of psychological distress: a Global Severity Index, Positive Symptom Distress Index, and Positive Symptom Total. For purposes of this study, only the Global Severity Index was calculated, which combines all 53 items into a single score. BSI items are rated on a five-point scale ranging from "Not at all" (1) to "Extremely" (5). Participants are also allowed to "Refuse to answer" to any of the question, which is scored as an 8. This general measure of psychopathology takes into account symptom dimensions such as: depression, anxiety, psychoticism, and somatisation symptoms occurring during the past week. Example items include "Feeling easily annoyed or irritated", "Feeling that most people cannot be trusted", and "Feeling blue". Reliability estimates (standardised Cronbach alphas) were .96 for both mothers (n=288), and fathers (n=214).

Parental warmth was assessed using the "Parental Feelings" questionnaire (Asbury, Dunn, & Plomin, 2006; Deater-Deckard, 2000), a seven-item measure graded on a five-point scale ranging from "Definitely True" to "Definitely Untrue". Items include statements such as "I usually feel close to him/her", and "Sometimes I feel very impatient with him/her". The scale had a standardised Cronbach alpha of .77 for mothers and .80 for fathers.

Children's CU traits were assessed by parent and teacher responses to the Antisocial Process Screening Device (Frick & Hare, 2001) CU subscale, the APSD is a 20-item measure graded on a 3-point scale ranging from "Not at all true" to "Definitely true". Example items include: "Lies easily and skillfully" and "Feels bad or guilty when he/she does something wrong". The APSD was previously used in Loney and colleagues' study (Loney et al., 2007), which to our knowledge is the most similar investigation into inter-generational stability of CU traits. The APSD includes three subscales: narcissism, impulsivity, and CU traits, only the CU subscale was used in this study, which is comprised of the sum of 6 items. Reliability

estimates (standardised alphas) for each informant category of the CU subscale were: .61 for mothers, .60 for fathers, and .66 for teachers.

Analytic Plan

Given the study includes multiple-informants, sample size varied depending on the number of measures that had been completed by families. Missing-data analysis, included as Appendix A, revealed no differences in DV scores between groups with/without missing data. Moreover, differences in household structure were not related to CU traits. Given there were three different CU measures for each child (mother-, father- and teacher-rated APSD CU scores) separate analyses were conducted for mothers and fathers. Differences between maternal and paternal demographic variables are presented below.

The analysis was carried out in three stages. First, the findings of Loney and colleagues (2007), indicating a positive relationship between factor 1 of the mother's LSRP scale, and children's CU traits (APSD) were replicated. This was accomplished through partial correlations, controlling for age. These results were extended by the addition of paternal LSRP scores, as well as the inclusion of girls in the analysis. Second, four regression models were used to test hypothesis 1 and 2; whether parental psychopathy factors predicted children's CU traits, and whether these variables continued to explain unique variance in CU scores over and above that explained by common psychopathological factors. This was achieved using blocked regression models, the first block of which tested the relationship between parental LSRP scores and CU traits (as rated by both parents), and the second of which included parenting behaviors, parental psychopathology, and warmth. Third, to test the third hypothesis regression models were used including only significant predictors from the analysis above, in addition to interaction terms between gender and these predictors. To do this all the main study variables (children's CU traits, parental psychopathy factors 1 and 2,

parental feelings (warmth), harsh parenting, and parental psychopathology) were standardised and gender was recoded as (-1 = boys, 1 = girls). To disentangle the interactions uncovered by the models described above the sample was split by gender and the influence of parental psychopathy was tested separately for boys as compared to girls.

Results

Table 1.1 presents descriptive statistics for the main variables, as well as statistical differences between mothers and fathers. There was only one statistically significant difference between boys and girls, with fathers reporting higher factor 2 psychopathy among boys (M_{boys} = 19.76, M_{girls} = 18.07, t (225) = 2.014, p = .034).

Part 1. Relationship between psychopathy scores in parents and CU traits in children

This attempt to replicate Loney and colleagues' (2007) results suggesting a positive relationship between maternal LSRP scores and children's CU traits (as determined by the mother's APSD ratings) was successful in a combined sample including both boys and girls (n = 220). Their mother's LSRP total score was positively related to maternal reports of CU traits in the child (r = .18, p = .018). This relationship was significant for both factor 1 (r = .15, p = .025) and factor 2 (r = .15, p = .026) scales of the LSRP.

These analyses were then performed substituting maternal APSD ratings of CU traits for those of the child's father and teacher. This was not replicated for the father's ratings of CU traits and the mother's total LSRP score (n = 220, r = .10, p = .135), or either factor (1: r = .07, p = .308; 2: r = .09, p = .206). Similarly, there was no significant relationship between maternal LSRP and teacher-reported CU traits (n = 228), for neither the full scale or factors 1 (r = .05, p = .488), and 2 (r = .09, p = .199).

Table 1.1 Descriptive Statistics

		Mothers		Fathers	
All Children	Mean	SD	Mean	SD	t
Parenting (APQ)	28.26	5.08	29.64	5.30	-3.60***
Psychopathology (BSI)	30.95	28.00	27.22	23.75	1.79
Feelings (PFQ)	22.51	4.65	20.12	5.36	5.75***
Factor 1 Psychopathy (LSRP)	22.59	5.86	25.74	6.75	-6.28***
Factor 2 Psychopathy (LSRP)	18.69	4.48	19.13	5.18	-1.04
CU Traits (APSD)	5.29	2.20	5.25	2.19	.31
Age	7.57	2.99			
Boys					
Parenting (APQ)	28.33	5.26	29.92	5.31	-3.51***
Psychopathology (BSI)	34.31	29.93	29.64	26.55	1.28
Feelings (PFQ)	22.07	4.62	20.49	5.25	3.59***
Factor 1 Psychopathy (LSRP)	22.87	5.87	26.04	7.00	-5.48***
Factor 2 Psychopathy (LSRP)	19.14	4.45	19.76	6.15	-1.18
CU Traits (APSD)	5.20	2.18	5.33	2.15	-.20
Age	7.65	2.91			
Girls					
Parenting (APQ)	28.09	4.63	28.96	5.24	-1.19
Psychopathology (BSI)	29.12	26.36	22.85	19.04	1.31
Feelings (PFQ)	22.87	4.80	19.45	5.55	4.75***
Factor 1 Psychopathy (LSRP)	23.56	6.50	25.08	5.72	-3.18**
Factor 2 Psychopathy (LSRP)	18.56	4.04	18.07	4.13	.04
CU Traits (APSD)	5.17	2.26	5.03	2.29	.39
Age	7.35	3.20			

Mean and standard deviations with results from paired sample t-tests comparing Mother and Father variables in the adjacent column.

Loney's (2007) analysis was then extended by investigating the relationship between fathers' LSRP scores and children's CU traits (as determined by the father's APSD ratings). This relationship was not significant for the total scale (n = 221, r = .12, p = .077), or factor 2 scores (r = .05, p = .438), but was significant for factor 1 (r = .14, p = .037). When substituting father's ratings of CU traits for those of mothers and teachers the father's factor 1 of the LSRP had a significant positive relationship with maternal reports of CU traits (n = 219, r = .18, p = .006). This relationship was not significant for factor 2 (r = .003, p = .961). The father's factor 1 (r = .09, p = .222) and factor 2 (r = -.03, p = .719) scales were not related to teacher reports (n = 184) of CU traits. The results of these analyses are displayed in Table 1.2 below.

Part 2. Specificity of psychopathy factors as predictors of CU traits

The second hypothesis was concerned with whether parental LSRP scales continued to predict unique variance in children's CU traits beyond the influence of other risk variables. Blocked regression models using CU traits (APSD) as the dependent variable (DV) and age, negative parenting (APQ), warmth (parental negative feelings; PFQ), parental psychopathology (BSI), and parental psychopathy (LSRP) as the independent variables (IVs) resulted in a total of four models: using either maternal or paternal variables (APQ, PFQ, BSI) as the IVs, and either father or mother ratings of CU traits as the DVs. Table 1.3 displays results pertaining to models using parental variables (warmth, harsh parenting, and parental psychopathology) as predictors.

Mother variables as predictors. The first two models used the mother's psychopathy factors to predict maternal ratings of CU traits (n = 296); as well as paternal ratings of CU traits (n = 220). The full results of these models can be seen in the top half of Table 1.3. In the first block the mother's psychopathy factor 2 was a significant predictor of CU traits (B =

.15, SE = .03, *p* = .025), but only when using the mother's CU ratings as the DV. The second block included the mother's warmth (negative feelings), harsh parenting, psychopathology, and age. After the inclusion of these variables only the mother's warmth was a significant predictors of CU traits (B = .25, SE = .03, *p*<.001). As before, this occurred only when using mother-rated CU traits, and not when using father-rated CU traits.

Father variables as predictors. Then blocked design was repeated using the fathers' variables to predict CU traits as rated by mothers (n = 296) and fathers (n = 221). The full results of these models can be seen in the lower half of Table 1.3. In the first block the father's psychopathy factor 1 significantly predicted CU ratings made by both mothers (B = .25, SE = .02, *p* < .001) and fathers (B = .15, SE = .02, *p* = .046). The other paternal variables were then added in the second block. The father's psychopathy factor 1 remained a significant predictor of both mother (B = .24, SE = .02, *p* = .002) and father (B = .15, SE = .02, *p* = .041) ratings of CU traits. Additionally, the father's warmth (negative feelings) was a significant predictor of father-rated CU traits (B = .25, SE = .03, *p* = .001), but not mother-rated CU traits. Fathers' factor 2 psychopathy was a significant predictor of mother, but not father, rated CU traits (B = -.18, SE = .03, *p* = .037.

Part 3. Testing gender effects on the main predictors of CU traits

The third hypotheses postulated different pathways to the development of CU traits in boys and girls. In order to test this hypothesis, a second group of models was employed, including only the significant predictors from the second phase of the analysis, as well as interactions between these and gender, displayed in Table 1.4. These models used different variables for mothers and fathers, as per the results above. Maternal variables included factor 2 psychopathy and warmth, with gender and the interaction of factor 2 psychopathy and warmth with gender entered as a second block. Paternal variables included both factor 1 and 2, as well

as warmth; as before, gender, and the interaction of all variables with gender, were entered as a second block.

Mother variables as predictors. Maternal factor 2 psychopathy and warmth (negative feelings) were both strong predictors of mother-rated CU traits, with only warmth reaching significance (warmth: B = .24, SE = .06, $p < .001$; factor 2: B = .10, SE = .06, $p = .074$). These associations were not replicated when using father-rated CU traits. In the second block, the interaction between factor 2 and gender was strongly associated with mother-rated CU traits (B = -.13, SE = .07, $p = .056$), as was maternal warmth (B = .21, SE = .06, $p = .001$). In contrast, the mother's factor 2 psychopathy was no longer predictive of CU traits. These associations were not replicated in father-rated CU traits.

Father variables as predictors. Paternal factor 1 psychopathy and warmth were both strong predictors of both mother-rated CU traits (factor 1: B = .21, SE = .07, $p = .004$; warmth: B = .14, SE = .07, $p = .047$) and father-rated CU traits (factor 1: B = .14, SE = .07, $p = .057$, which trended in the same direction, but was not significant; and warmth: B = .27, SE = .07, $p < .001$). After the inclusion of gender interactions factor 1 was no longer associated with neither mother- nor father-rated CU traits. In contrast, warmth was significant across both parents. The interaction between factor 1 and gender was significant in predicting father-rated CU traits (B = -.19, SE = .09, $p = .046$).

Disentangling gender effects. To investigate these effects the sample was split by gender and a regression model with a single predictor was used. In mothers, the interaction between factor 2 psychopathy and gender was associated with CU traits, therefore the role of factor 2 psychopathy was analysed separately for boys and girls. In boys, factor 2 psychopathy was significant associated with mother-ratings of CU traits (n = 218, B = .23, SE = .06, $p = .001$) and marginally associated with father-ratings of CU traits (n = 158, B = .15, SE = .07, p

= .062). In neither model was factor 2 psychopathy associated with girls' CU ratings, albeit their sample size was smaller (n = 81, n = 63).

In fathers, the interaction between factor 1 psychopathy and gender was associated with CU traits. For boys, psychopathy factor 1 was significantly associated with both mother-ratings of CU traits (n = 158, B = .27, SE = .07, p = .001) and father-ratings of CU traits (n = 160, B = .23, SE = .07, p = .003). As before, neither of these relationships was replicated across the smaller sample of girls (n = 62).

Table 1.2. Partial correlations between main study variables, controlling for Age.

Measure	1	2	3	4	5	6	7	8	9
1. Mother-rated CU traits	–								
2. Father-rated CU traits	**.45*****	–							
3. Teacher-rated CU traits	**.31*****	.10	–						
4. Mother's Factor 1 Psychopathy	**.15***	.07	.05	–					
5. Mother's Factor 2 Psychopathy	**.15***	.09	.09	**.54*****	–				
6. Father's Factor 1 Psychopathy	**.18****	**.14***	.09	**.31*****	**.17***	–			
7. Father's Factor 2 Psychopathy	.003	.05	-.03	.07	**.15***	**.43*****	–		
8. Mother's APQ	**.17***	**.15***	-.04	**.24*****	**.22*****	**.15***	.09	–	
9. Father's APQ	.14	.04	.12	**.19****	.12	**.32*****	**.20****	**.34*****	–

Bold items indicate significance. *$p < .05$, **$p < .01$, ***$p < .001$

Table 1.3. Blocked regression models predicting mother- and father-rated CU traits using parental variables

			Mother-Rated CU Traits			Father-Rated CU Traits		
			B (Std. Error)	t	p	B (Std. Error)	t	p
Mother Variables	1	Constant	-	5.91	<.001	-	6.29	<.001
		Factor 1 Psychopathy	.02 (.02)	.28	.777	.03 (.03)	.33	.738
		Factor 2 Psychopathy	**.15 (.03)**	**2.26**	**.025**	.08 (.04)	1.01	.313
	2	Constant	-	1.38	.168	-	2.43	.016
		Factor 1 Psychopathy	.07 (.02)	1.00	.316	.02 (.03)	.29	.772
		Factor 2 Psychopathy	.07 (.04)	.88	.382	.02 (.04)	.17	.863
		Negative Parenting	.01 (.03)	.10	.921	.11 (.03)	1.49	.137
		Warmth (Negative Feelings)	**.25 (.03)**	**3.99**	**<.001**	.02 (.04)	.30	.766
		Psychopathology	.00 (.01)	-.01	.995	.06 (.01)	.72	.475
		Age (Years)	.02 (.04)	.35	.730	.09 (.05)	1.34	.183
Father Variables	1	Constant	-	6.19	<.001	-	6.28	<.001
		Factor 1 Psychopathy	**.25 (.02)**	**3.41**	**.001**	**.15 (.02)**	**2.01**	**.046**
		Factor 2 Psychopathy	-.10 (.03)	-1.38	.170	-.01 (.03)	-.07	.943
	2	Constant	-	2.98	<.001	-	2.76	.006
		Factor 1 Psychopathy	**.24 (.02)**	**3.14**	**.002**	**.15 (.02)**	**2.06**	**.041**
		Factor 2 Psychopathy	**-.18 (.03)**	**-2.10**	**.037**	-.13 (.03)	-1.61	.109
		Negative Parenting	.05 (.03)	.63	.533	-.02 (.02)	-.33	.741
		Warmth (Negative Feelings)	.11 (.03)	1.44	.152	**.25 (.03)**	**3.36**	**.001**
		Psychopathology	.08 (.01)	1.07	.287	.11 (.01)	1.48	.141
		Age (Years)	.01 (.05)	.11	.910	.06 (.05)	.85	.399

a. DV: Mother-rated CU traits: Both models using mother variables were significant (Model 1: $F(2,294) = 3.90$, $p = .021$, Adj $R^2 = .019$; Model 2: $F(6, 290)=4.45$, $p < .001$, Adj $R^2 = .065$). Models using father variables were significant (Model 1: $F(2,216) = 5.83$, $p = .003$, Adj $R^2 = .042$; Model 2: $F(6, 212) = 2.85$, $p = .011$, Adj $R^2 = .049$).

b. DV: Father-rated CU traits. Neither model using mother variables was significant (Model 1: $F(2,218) = 1.01$, $p =.367$, Adj $R^2=.00$; Model 2: $F(6, 214) = 1.45$, $p = .196$, Adj $R^2 = .012$). The second model using father variables was significant (Model 1: $F(2,219) = 2.36$, $p = .097$, Adj $R^2 = .012$; Model 2: $F(6, 215) = 4.04$, $p = .001$, Adj $R^2 = .076$).

c. B are standardised coefficients. All variables (Psychopathy, Negative Parenting, Negative Feelings, and Psychopathology) relate to the mother in the first half of the table, and to the father on the second half.

Table 1.4. Regression models testing gender interactions with standardised variables

			Mother-Rated CU Traits			Father-Rated CU Traits		
			B (Std. Error)	t	p	B (Std. Error)	t	p
Mother Variables	1	Constant	-	-.27	.789	-	.30	.761
		Factor 2 Psychopathy	**.10 (.06)**	**1.79**	**.074**	.08 (.07)	1.13	.259
		Warmth (Negative Feelings)	**.24 (.06)**	**4.18**	**<.001**	.05 (.07)	.78	.439
	2	Constant	-	-.57	.567	-	-.38	.702
		Factor 2 Psychopathy	.03 (.07)	.43	.669	.01 (.08)	.16	.871
		Warmth (Negative Feelings)	**.21 (.06)**	**3.33**	**.001**	.05 (.08)	.64	.522
		Gender	-.04 (.06)	-.64	.525	-.08 (.08)	-1.19	.236
		Factor 2 * Gender	**-.13 (.07)**	**-1.92**	**.056**	-.11 (.08)	-1.32	.190
		Warmth * Gender	-.06 (.06)	-.96	.339	-.01 (.08)	-.17	.868
Father Variables	1	Constant	-	.48	.630	-	-.48	.629
		Factor 1 Psychopathy	**.21 (.07)**	**2.94**	**.004**	**.14 (.07)**	**1.91**	**.057**
		Factor 2 Psychopathy	-.12 (.07)	-1.65	.101	-.08 (.07)	-1.11	.268
		Warmth (Negative Feelings)	**.14 (.07)**	**2.00**	**.047**	**.27 (.07)**	**4.06**	**<.001**
	2	Constant	-	.09	.932	-	-1.02	.311
		Factor 1 Psychopathy	.12 (.10)	1.27	.204	.02 (.09)	.22	.823
		Factor 2 Psychopathy	-.14 (.11)	-1.29	.199	-.09 (.11)	-.80	.422
		Warmth (Negative Feelings)	**.15 (.07)**	**1.97**	**.050**	**.27 (.07)**	**3.82**	**<.001**
		Gender	-.03 (.08)	-.41	.680	-.06 (.07)	-.96	.339
		Factor 1 * Gender	-.15 (.10)	-1.56	.120	**-.19 (.09)**	**-2.01**	**.046**
		Factor 2 * Gender	-.04 (.11)	-.33	.740	-.01 (.11)	-.09	.931
		Warmth * Gender	.02 (.08)	.27	.789	-.00 (.07)	-.04	.971

a. DV: Mother-rated CU traits: Both models using mother variables were significant (Model 1: $F(2,295) = 12.82$, $p < .001$, Adj $R^2 = .074$; Model 2: $F(5, 292) = 6.27$, $p < .001$, Adj $R^2 = .082$). Models using father variables were significant (Model 1: $F(3,218) = 4.38$, $p = .005$, Adj $R^2 = .044$; Model 2: $F(7, 214) = 2.49$, $p = .018$, Adj $R^2 = .045$).

b. DV: Father-rated CU traits. Neither model using mother variables was significant (Model 1: $F(2,219) = 1.26$, $p = .287$, Adj $R^2 = .002$; Model 2: $F(5, 216) = 1.09$, $p = .368$, Adj $R^2 = .002$). Both models using father variables were significant (Model 1: $F(3,220) = 7.13$, $p < .001$, Adj $R^2 = .076$; Model 2: $F(7, 216) = 4.02$, $p < .001$, Adj $R^2 = .087$).

c. B are standardised coefficients. All variables (Psychopathy, and Negative Feelings) relate to the mother in the first half of the table, and to the father on the second half.

Table 1.5. Investigating gender interactions by investigating boys and girls separately.

			Mother-Rated CU Traits			Father-Rated CU Traits		
			B (Std. Error)	t	*p*	B (Std. Error)	t	*p*
Mother Factor 2 * Gender	Boys	Constant	-	-.06	.951	-	.82	.415
		Factor 2 Psychopathy	**.23 (.06)**	**3.51**	**.001**	**.15 (.07)**	**1.88**	**.062**
	Girls	Constant	-	-.12	.905	-	-.76	.452
		Factor 2 Psychopathy	-.06 (.12)	-.49	.625	-.07 (.14)	-.56	.576
Father Factor 1 * Gender	Boys	Constant	-	.49	.628	-	.12	.903
		Factor 1 Psychopathy	**.27 (.07)**	**3.53**	**.001**	**.23 (.07)**	**2.98**	**.003**
	Girls	Constant	-	-.11	.915	-	-1.22	.228
		Factor 1 Psychopathy	-.07 (.16)	-.51	.612	-.13 (.15)	-1.04	.302

a. Mother Factor 2 * Gender: When using mother-rated CU traits as the DV, Factor 2 was significant only for boys (Model 1: $F(1,217) = 12.30$, $p = .001$, Adj $R^2 = .049$; Model 2: $F(1, 80) = .24$, $p = .625$, Adj $R^2 = .003$). When using father-rated CU traits as the DV, Factor 2 trended towards significance for boys, but not girls (Model 1: $F(1,157) = 3.54$, $p = .062$, Adj $R^2 = .016$; Model 2: $F(1, 62) = .32$, $p = .576$, Adj $R^2 = -.011$).

a. Father Factor 1 * Gender: When using mother-rated CU traits as the DV, Factor 1 was significant only for boys (Model 1: $F(1,157) = 12.45$, $p = .001$, Adj $R^2 = .068$; Model 2: $F(1, 61) = .26$, $p = .612$, Adj $R^2 = -.012$). When using father-rated CU traits as the DV, Factor 1 was significant only for boys (Model 1: $F(1,159) = 8.88$, $p = .003$, Adj $R^2 = .047$; Model 2: $F(1, 61) = 1.08$, $p = .302$, Adj $R^2 = .001$).

c. B are standardised coefficients. Factor 2 Psychopathy refers to the mother's scores, whereas Factor 1 scores refer to the father's scores. Note that only these interactions were tested as these came up as significant in the analysis demonstrated in Table 1.4.

Discussion

Intergenerational associations between psychopathy factors in parents and CU traits in their children were assessed, first by looking at correlations, and then whether these associations survived competing explanations (risk variables). The first hypothesis, that the presence of psychopathic traits in parents was associated with CU traits in children was confirmed, as the presence of psychopathic features in parents was associated with children's CU traits. In this sample both maternal psychopathy factors (1 and 2), as well as fathers' factor 1, were associated with CU traits as rated by the mother. These results therefore agree with Loney et al. (2007), who found an association between maternal factor 1 psychopathy and children's CU traits. Moreover, the association between the fathers' factor 1 scores and children's CU traits was replicated when using father-rated CU traits as the dependent variable. Neither relationship was able to be replicated when using teacher-reported CU traits, which had a lower correlation with parental scores, as displayed in Table 1.2.

These findings are broadly consistent with those of Loney et al. (2007) and Hyde et al. (2016), who found maternal psychopathy to be associated with CU traits, and this relationship to be mediated by parenting. Loney and colleagues (2007) found a relationship between mothers' psychopathy factor 1 and CU traits in a mixed-gender sample of children. This relationship was replicated in the combined sample for both maternal psychopathy factors, albeit only when mothers themselves rated children's CU traits. Unlike these studies (Hyde et al., 2016; Loney et al., 2007), these results also suggested an important association between paternal psychopathy scores and their children's CU traits, as the relationship between the fathers' factor 1 score and CU traits was replicated across informants.

Next, it was investigated whether parents psychopathic traits conferred specific risk for CU traits, or whether they indexed general risk, in the same way other risk factors might be

expected to. This relationship was tested with blocked regression models: first, by analyzing whether parental psychopathy factors were significant predictors of CU traits, and later whether these effects remained after the inclusion of other risk variables (warmth, harsh parenting, and general parental psychopathology). The first part of this analysis showed that both the father's factor 1 and the mother's factor 2 significantly predicted CU traits, albeit the mother's factors 2 only predicted CU traits as rated by the mother, and not the father. In contrast, the father's factor 1 predicted CU traits as indexed by both mother and father reports.

Then other parental risk variables were included in the regression model, which had different effects for each parent. For mothers, the effect of factor 2 scores on CU traits in children disappeared, and maternal warmth became the main predictor of CU traits. Father's psychopathy factor 1 remained a significant predictor of CU traits in children for both mother and father-reported CU traits. Two other variables significantly predicted CU traits, albeit not across both parents. The father's warmth predicted father-rated CU traits (but not mother-ratings), in a relationship that mirrored that of the mother. That is, when the warmth and CU traits were rated by the same parent, warmth appeared to be a significant predictor of CU traits. The father's psychopathy factor 1 score was significantly associated with mother-rated CU traits.

Overall, these results suggest important roles for parental warmth (across both parents) in the prediction of CU traits; as well as parent-specific associations between psychopathy factors and CU traits. In mothers, only the mother's secondary factor was significantly associated with CU traits in the regression models, and this relationship disappeared when including other parenting components (notably warmth). This is consistent with the notion that maternal warmth mediates the relationship between the mother's psychopathic behaviors and the emergence of CU traits in children. Loney and colleagues (2007) had reported a

similar mediation in which the mother's harsh parenting mediated the relationship between her psychopathic traits and the child's CU. In this study the mother's harsh parenting was not a significant predictor of CU traits, but rather her warmth. However, it is important to note that mediation was not directly tested in this paper as all variables were collected at the same point in time. Factor 2 scores, similar to that of Hare's PCL-R (Hare & Vertommen, 1991), capture current antisocial behavior rather than childhood conduct problems preceding psychopathy (Flores-Mendoza, Alvarenga, Herrero, & Abad, 2008). In this sense, it is not surprising that there is some overlap between factor 2 scores and harsh parenting (measured with the APQ), as both capture some impulsivity and negativity in the parent. Like Loney et al. (2007), this study found other maternal risk factors better accounted for the relationship between psychopathy factor 2 and mother-rated CU traits, suggesting future studies should investigate a mediation between these variables. It is possible that positive parental feelings protect children from experiencing their mother's maladaptive behavior; likewise, negative parental feelings may exacerbate harsh parenting and expose the child to behaviors consistent with an antisocial presentation. This association is supported by prior literature describing the effects of stress on parenting (Patterson, 1982; Rodriguez & Green, 1997), which suggests that heightened stress may lead to increasingly maladjusted parenting practices (Anthony et al., 2005), see also the work of Fanti & Centifanti (2014). Therefore, it is sensible to suggest that while the mother's behavior is likely to be associated with the emergence of CU traits, this behavior may not necessarily be limited to "psychopathic" behavior, and indeed looking towards other domains such as warmth is likely to yield promising results (Pasalich, Dadds, Vincent, et al., 2012).

In fathers, there was a strong relationship between psychopathy factor 1 scores and children's CU traits across informants, which remained significant after the inclusion of other risk variables. A similar relationship had previously been reported in adult men with regards

to psychopathy profiles, and not CU traits (Auty et al., 2015). However Auty and colleagues (2015) found the father's factor 2 scores to be the most reliable indicator of a psychopathic profile, whereas this relationship was only replicated when using mother-rated CU traits (and after accounting for other variables) in the analysis. Rather, these findings suggest fathers' factor 1 scores are the strongest predictor of children's CU traits. This supports the notion that there are shared characteristics between fathers and their children which are not shared by the mother. Previous findings in naturalistic settings had found that fathers, but not mothers, of children with CU traits showed similar impairments in the amount of eye-contact they made with their children (Dadds et al., 2011). Likewise, the amount of eye-contact made by CU children during an "expression of love" task was found to be related to the father's levels of psychopathy, but not the mothers (Dadds et al., 2014).

Lastly, gender-effects were examined with a third set of models, including interactions between significant predictors and gender (for mothers: factor 2 psychopathy and warmth; for fathers: both factors and warmth). Two interactions between gender and parenting variables approached significance: the mother's factor 2 psychopathy score and the father's factor 1 psychopathy score. These two interactions were investigated further by splitting the sample by gender and looking at these effects separately for boys and girls. As displayed in Table 1.4., the mothers' factor 2 scores were associated with CU traits in boys (but not girls) across both mother- and father-rated CU traits. Similarly, the fathers' factor 1 scores were associated with boys (but not girls) across both mother- and father-rated CU traits. The replication of findings across informants is indicative of a robust relationship between parental psychopathy factors and boys' CU traits; however, as noted below, the lower sample size in girls limits our ability to draw strong inferences from their results.

Gender-specific investigations regarding the development of antisocial behavior suggest different presentations between males and females (Silverthorn & Frick, 1999).

Unlike Loney et al. (2007) and Hyde et al. (2016) findings from this study did not replicate the associations between parental psychopathy and CU traits in girls. Auty et al. (2015), who was able to find an association between the father's psychopathy and adult female's CU traits, also found that it was the indirect effects of the father's psychopathy which were most important in this prediction. This could suggest a greater role for environmental variables in girls' development of CU traits. For example, these findings show that parental warmth significantly predicted CU traits, (and showed no gender effects) although this association was not the focus of the current study. Instead, the results support a relationship between boys and their fathers' factor 1 psychopathy – suggesting constitutional similarities – alongside the influence of parenting variables such as warmth. This raises the prospect that boys in particular may carry familial risk associated with their fathers' phenotypic characteristics.

As noted above, there was a substantially smaller number of girls and therefore less power in these analyses. However, note that their standardised beta coefficients do not follow the same direction as those in boys, so it is unclear whether a larger sample would have resulted in the same results across genders. Another possible explanation for the gender differences could be due to the variance of CU scores. However, no significant gender differences were found in the variance of CU ratings for any specific rater. Although it is likely that these gender differences are important, as all significant associations with parental psychopathy factors were driven by boys, do note that mixed-gender models found these relationships to be significant.

This study is subject to several limitations. It used cross-sectional data and all variables were assessed through self-reports. An attempt to mitigate this was carried out by using multiple informants, yet interpreting the differences between these informants can be challenging (they might reflect real differences, just as they might reflect a disparity of

attribution or perception). The use of multiple informants is an important strength of the current study, as it provides a better understanding of (in)consistent behavior across varying contexts.

This study sought to replicate and expand the findings of previous studies which had found some evidence for intergenerational stability between CU traits in mothers and their children (Loney et al., 2007). As well as related studies showing similar signs of stability (Auty et al., 2015; Hyde et al., 2016; Kahn et al., 2016). This study expanded this previous attempt by using children and parents of both genders, and analyzing the influence of common risk variables and child gender. The findings of Loney and colleagues (2007) were replicated in maternal reports of CU traits, with the addition of fathers' factor 1 psychopathy also being significantly associated to the study's outcome. The relationship between the mother's psychopathy and the child's CU traits disappeared when including other parenting factors, such as parental feelings and harsh parenting practices. In contrast, the relationship between the fathers' factor 1 scores and child CU traits remained significant, and was replicated across informants (in effects that were stronger for boys as compared to girls). This study highlighted the role of maternal care in the emergence of CU traits, as a successful moderator of the risk associated with trait-like features, hence it was decided that future studies would focus on the relationship between mothers and their children.

An attachment framework was used to explore the socio-emotional development of the dyad. This revealed that previous studies had found associations between CU traits and disorganised attachment (Bohlin et al., 2012; Pasalich, Dadds, Hawes, et al., 2012); importantly, this suggested specific mechanisms (e.g. fear, a threatening mother) for the transmission of socio-emotional disturbance across generations. It was decided that new tools needed to be developed to test whether the specific mechanisms associated with attachment disorganisation were applicable to children with high levels of CU traits.

STUDY 2: VALIDITY AND RELIABILITY OF TWO MEASUREMENT TOOLS: THE CHILD AFFECTIVE BEHAVIOURS SCALE AND THE INTERVIEW ON CRITICAL BONDING MOMENTS

The results from study one suggested maternal behaviours and warmth were particularly important for the development of CU traits, an effect that was strongest for boys, but which remained significant when compared across genders. The attachment literature offers a strong framework formulating predictions regarding transmission associated with interpersonal disturbance (Madigan et al., 2006), aligning well with previous findings suggesting an association between attachment disorganisation and CU traits. More specifically, it suggests that maternal states of mind during the first year of life (e.g. fear, depression, disinterest) and their relationship with their infants (e.g. perceived closeness, bonding, attachment security) were important predictors of healthy socio-emotional development (Lyons-Ruth & Jacobvitz, 2008). At the same time, the attachment literature downplayed the role of the infant (e.g. particularly temperament) as a key factor in the infant's socio-emotional development (van Ijzendoorn et al., 1999). However, it is precisely these constitutional characteristics of the infant which are considered core to the CU construct (Larsson, Viding, & Plomin, 2008; Viding et al., 2009). This contradiction highlighted the need for new tools which could capture: (1) maternal states of mind and perceived relationship to their child throughout the formative moments of the child's socio-emotional development, and (2) behavioural displays of the child's affect.

The measure of children's affective behaviours was designed to measure internal constitutional characteristics of the child, while the measure of the mother's narrative around her early bonding experiences was designed to index her affect during critical bonding moments. The psychometric properties of these measures were checked using mixed-samples made up of clinic and community participants. These two new measures are the Child

Affective Behaviours (CAB) scale and the Interview on Critical Bonding Moments (ICBM).

As the structure of each measure necessitates unique analysis, psychometric tests are reported

separately for each measure.

Part 1: The Child Affective Behaviour Scale

The two most established procedures for measuring child attachment are

thought to be the strange situation procedure (SSP) and story-stem attachment tasks (i.e.

ASCT, MCAST). The CAB was developed as these attachment measurement tools were

subject to several limitations. Mainly, they typically assess attachment responses to specific

scenarios, whereas this investigation was interested in broader affective responses: including

eye-gaze and expressions of love/affection as well as more traditional dimensions such as

proximity-seeking and ability to be soothed. Additionally, the administration of these

measures presents significant challenges: they require the assessment be conducted within a

narrow age range; can be traumatic for participants (Granqvist et al., 2016); require serial (as

opposed to parallel) assessments; and require specialised training programs that are not easily

accessible to researchers. These limitations meant that they could not be administered within

the constraints of our data collection process. Lastly, these measures are coded into

attachment categories, and generally include a continuous score only for disorganised

attachment ratings. Although there is precedent for establishing a continuous measure of

attachment, notably from a re-coding of the SSP. For this study, we wished to administer a

brief parent-completed measure, which provided a continuous score, and was grounded in

observable behaviours that could be accurately recalled by parents.

The CAB is therefore a measure of the child's component in parent-child interactions,

albeit one that is different to what is traditionally indexed by temperament. When focusing on

individual differences in patterns of infant behaviour – outside of the context of parent-child

interactions – questionnaires tend to focus on temperament; a construct grounded in physiological responses such as arousal which is akin to personality in children. However, the CAB is different from temperament measures in two respects: the first is that it incorporates the parents' subjective experience of children's individual differences, as suggested by items such as "My child seems to enjoy my displays of affection". This is an important distinction as it situates the child's responses within the context of a specific relationship. The second is that the CAB combines attributes that are segregated in measures of temperament (approach, cooperation, irritability) into a single dimension associated with the child's emotional processing. Therefore, while temperament is informative, we were not concerned with a general profile of the child's responsiveness to the environment, but rather with their specific affective responses to their attachment figures. Hence, we decided to create a scale that addressed these concerns.

Study 1a: Internal Structure of the CAB

Participants

The sample consisted of a large group of parents (n = 366) from both mental health clinics (n = 116) and the community (n = 250). Children from these families were mostly male (n = 221, 60.38%), with a mean age of 5.79 years (SD = 3.17, min = 2, max = 16). Community participants were recruited from local preschools, while clinic families attended one of our sites for the treatment of behaviour problems, and completed several measures before the start of treatment.

Measure

The CAB is a 12-item measure assessing children's affective behaviours, and includes items assessing the child's proximity-seeking, soothability (capacity to be soothed by his primary caregiver), expressions of love/affection, reception of love/affection, and eye gaze. Items include "My child doesn't like to be hugged" and "My child doesn't respond to my attempts to soothe him/her", assessed on a scale from 1 to 5. Items 5, 7, 8, 9, 10, and 11 are reverse-scored, and all items are summed to produce a total score.

Before assessing the internal structure of the CAB, the scale was shortened from an original number of 16 items down to 12, as these yielded the best internal reliability scores. The reduction resulted in 12 items, presented below in Table 2.1 and Table 2.2. The final scale consisted of 4 items related to love/affect, 4 items related to eye gaze, 2 items related to physical contact, and 2 related to soothing behaviours.

Design

First the internal reliability was assessed by calculating Cronbach's alpha on the final set of 12 items. Second, to test the internal structure of the measure participants were divided in half, with cases randomly-selected into each group by using a random number generator. One half of the sample underwent an exploratory principal component analysis, and these results were verified using a confirmatory factor analysis on the second half.

Results

This scale's internal reliability yielded a significant Cronbach alpha of .877 (.880 based on standardised items), $F_{(11,374)} = 28.63$, $p < .001$. The item-total correlations from this analysis are presented in Table 2.2. below, which also specifies which items were reverse-scored, and the subscale each item belongs to.

Table 2.1 Formatted CAB Questionnaire

CAB

Please read out each statement and decide how well it describes your child, select Strongly Disagree, Disagree, Undecided, Agree, or Strongly Agree. Please give your answers on the basis of the last six months.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. When I look at my child in the eye, he/she looks away.	1	2	3	4	5
2. My child doesn't like to be hugged.	1	2	3	4	5
3. My child doesn't seek either parent when distressed	1	2	3	4	5
4. When I try to show my child I love him/her, he/she doesn't seem interested.	1	2	3	4	5
5. I'm sure my child likes me	1	2	3	4	5
6. My child usually responds to my displays of emotion with a blank look.	1	2	3	4	5
7. My child likes to sit next to me when we do things together.	1	2	3	4	5
8. When others are loving towards my child, he/she responds with love and kindness.	1	2	3	4	5
9. Sometimes looking at my face is enough for my child to know how I feel.	1	2	3	4	5
10. My child seems to enjoy my displays of affection.	1	2	3	4	5
11. My child makes a normal amount of eye contact with me.	1	2	3	4	5
12. My child doesn't respond to my attempts to soothe him/her.	1	2	3	4	5

The CAB's internal structure was further assessed by splitting the sample into two random groups and conducting an exploratory principal component analysis (PCA) on one half of the sample and a confirmatory factor analysis (CFA) on the second half. To conduct

the exploratory PCA, we first analysed the eigenvalues of the first half, which suggested a single-factor solution, as specified in graph 2.1 below.

Table 2.2 CAB internal reliability statistics.

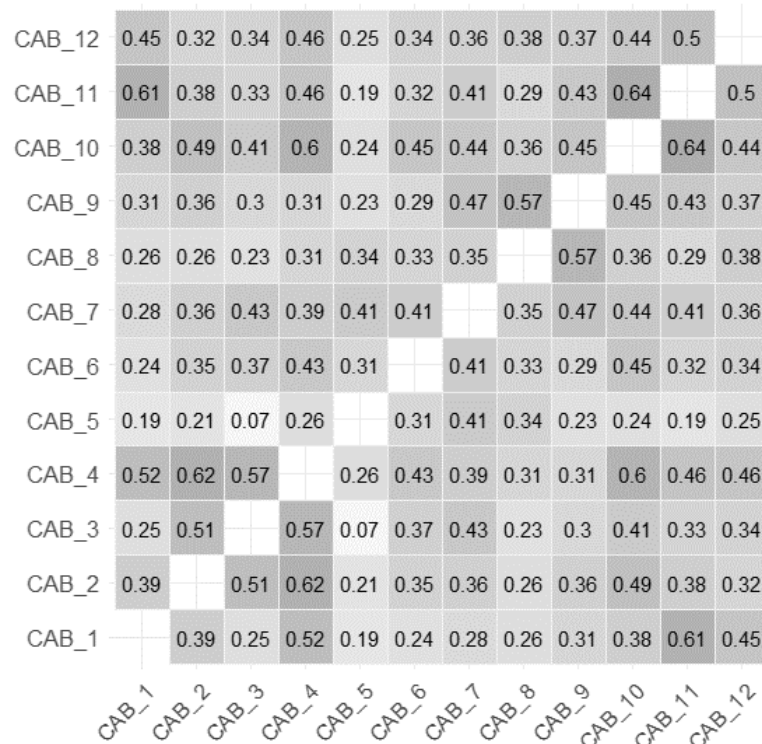| Item Labels	Scale	Reversed	Corrected Item-Total Correlations	PCA Standardised Loadings	CFA Standardised Coefficients (Loadings)
CAB_1	Eye Gaze	-	.529	0.63	0.57
CAB_2	Physical Contact	-	.564	0.68	0.63
CAB_3	Soothing Behaviours	-	.514	0.62	0.58
CAB_4	Love/Affection	-	.656	0.77	0.69
CAB_5	Love/Affection	R	.440	0.43	0.54
CAB_6	Eye Gaze	-	.526	0.61	0.61
CAB_7	Physical Contact	R	.584	0.67	0.59
CAB_8	Love/Affection	R	.570	0.58	0.71
CAB_9	Eye Gaze	R	.535	0.65	0.56
CAB_10	Love/Affection	R	.683	0.77	0.74
CAB_11	Eye Gaze	R	.708	0.73	0.83
CAB_12	Soothing Behaviours	-	.583	0.67	0.60

The scree plot below (Graph 2.1) depicts four analyses assessing the optimal number of dimensions underlying the PCA. The traditional approach has been to plot the eigenvalues and the components, and whenever components have eigenvalues larger than 1, it is assumed there is a dimension underpinning it. Graph 2.1 suggests that if this approached were used, there would be three components to the scale. However, more recent analyses have suggested

that numerical approaches are less likely to overestimate the number of dimensions, and outperform the traditional approach. Graph 2.1 shows results for three numerical approaches: parallel analysis, optimal coordinates, and an acceleration factor. Parallel analysis compares eigenvalues generated on random data to eigenvalues from the observed data, if the eigenvalues of the generated dataset are of higher magnitude to those of the observed data, the model assumes they are produced by random noise. The optimal coordinates method determined the location of the scree by creating an average slope for all component scores, and looking for values that significantly depart from the slope (outliers). Finally, the acceleration factor, indicated by (AE) in Graph 2.1, calculates the point at which the curve's slope changes most drastically. Notably, all three numerical analyses converge in suggesting a single component for the CAB scale.
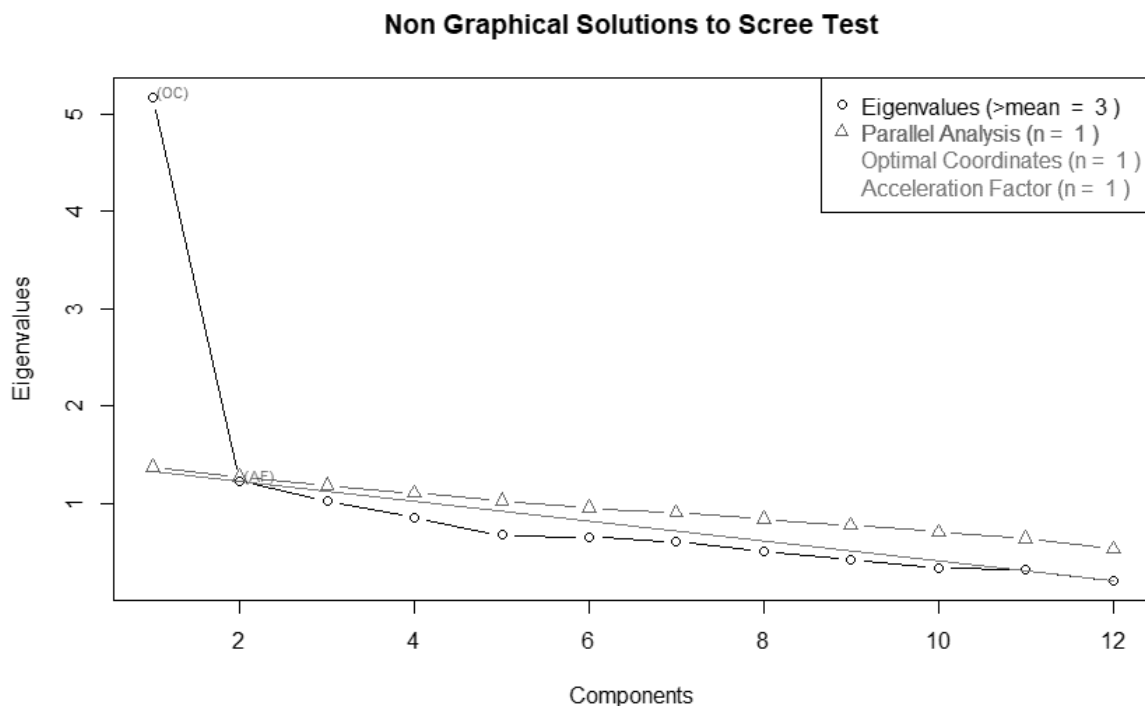

Graph 2.1 Scree plot depicting graphical and non-graphical solutions to the CAB's internal structure

Following from the scree plot an exploratory PCA was conducted with a single factor structure. The fit was judged to be adequate, with standardised loadings ranging from 0.43 to 0.77 (see full loadings in Table 2.2 above), and an RMSR of 0.10, $X^2 = 196.49$, $p < .001$. The proportion of variance in the single factor accounted for by the combination of items was 43%. With high correlations between items, as displayed in Graph 2.2 below.

	CAB_1	CAB_2	CAB_3	CAB_4	CAB_5	CAB_6	CAB_7	CAB_8	CAB_9	CAB_10	CAB_11	CAB_12
CAB_12	0.45	0.32	0.34	0.46	0.25	0.34	0.36	0.38	0.37	0.44	0.5	
CAB_11	0.61	0.38	0.33	0.46	0.19	0.32	0.41	0.29	0.43	0.64		0.5
CAB_10	0.38	0.49	0.41	0.6	0.24	0.45	0.44	0.36	0.45		0.64	0.44
CAB_9	0.31	0.36	0.3	0.31	0.23	0.29	0.47	0.57		0.45	0.43	0.37
CAB_8	0.26	0.26	0.23	0.31	0.34	0.33	0.35		0.57	0.36	0.29	0.38
CAB_7	0.28	0.36	0.43	0.39	0.41	0.41		0.35	0.47	0.44	0.41	0.36
CAB_6	0.24	0.35	0.37	0.43	0.31		0.41	0.33	0.29	0.45	0.32	0.34
CAB_5	0.19	0.21	0.07	0.26		0.31	0.41	0.34	0.23	0.24	0.19	0.25
CAB_4	0.52	0.62	0.57		0.26	0.43	0.39	0.31	0.31	0.6	0.46	0.46
CAB_3	0.25	0.51		0.57	0.07	0.37	0.43	0.23	0.3	0.41	0.33	0.34
CAB_2	0.39		0.51	0.62	0.21	0.35	0.36	0.26	0.36	0.49	0.38	0.32
CAB_1		0.39	0.25	0.52	0.19	0.24	0.28	0.26	0.31	0.38	0.61	0.45

Graph 2.2 Heatmap depicting item-item correlations for the CAB's 12 items. Darker shadings signal stronger correlations.

Lastly, a CFA was conducted with the second half of the sample. $X^2 (54) = 185.46$, $p < .001$. Standardised regression weights (loadings) ranged from .54 to .83, and all significantly loaded onto a single factor. The RMSEA was .121 (90% CI: .103 - .141), the Incremental Fit Index was .84 (values >.90 are considered optimal), and the Comparative Fit Index was .84 (with values > .93 considered optimal). The full model is specified below in Graph 2.3.
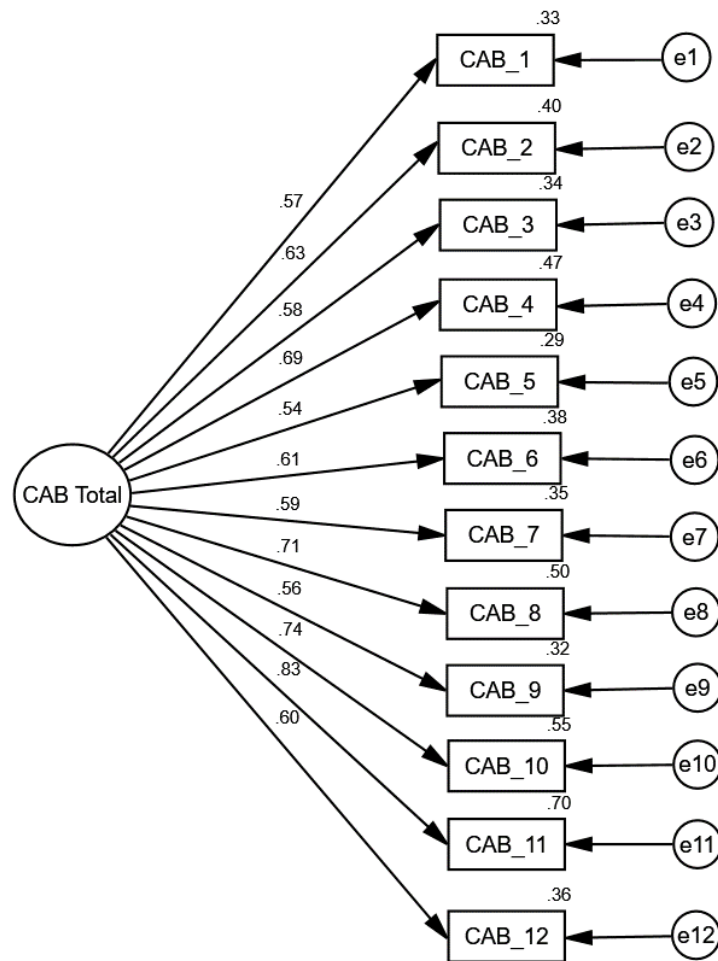
Graph 2.3 Path diagram used for the CFA testing CAB's structure.

As discussed above, Graph 2.3 is a visual display of the CFA, in which all items, represented by squares, load onto a single latent factor: a general CAB score. The numbers on the arrows going from the latent factor (total) to the individual items (numbered) represent each item's loadings. Circles to the right of the items represent the measurement error associated with each item.

Study 1b: Temporal reliability of the CAB

Participants

A small sub-sample of 23 parents from Study 1a were used to assess the temporal reliability of the CAB. This group was drawn from the community sample, had a mean age of 5.13 (SD = 2.47, with ages ranging from 2 to 11), and had an even gender distribution (12 males, 52.17%).

Design

Having established the internal reliability of the scale, its temporal reliability was tested with a subset of the previous sample which completed the questionnaire two months apart. Parents were aware that they would be asked to complete the CAB twice. At each time point, parents had a one-week period during which they could submit their responses electronically. Parents were reminded to submit their responses three times within the target weeks, at the start and end of the two-month period.

A correlational analysis was conducted to check the relationship between the two scores. A reliability analysis using total scores from each time-point was used to establish whether items could be grouped as a single measure. Lastly, a paired-sample t-test was used to test the hypothesis that there were no differences between time-points.

Results

Total CAB correlations two months apart were r = 0.44, $p = .06$. Correlations were marginally non-significant, but were of moderate to large magnitude, and likely to reach significance in larger samples. Reliability analysis had an alpha of 0.6 (95% CI: $0.27 - 0.92$),

suggesting concordance between items and that these could be grouped. Lastly, a paired sample t-test failed to reject the null hypothesis: t (19) = 0.15, *p* = .88, suggesting differences between time-point 1 (M: 16.09, SD: 3.85) and 2 (M: 15.75, SD: 4.49) did not reach significance in the present sample.

Study 1c: Inter-rater reliability of the CAB

Participants

The CAB's multi-informant or inter-rater reliability was assessed using a sub-sample of parents from study 1a (that did not overlap with the sample from study 1b). This sample consisted of 17 families, 16 of which were families attending a clinic for disruptive behaviour disorders. For these families reports were collected from both of the child's parents. The children's mean age was 8 (SD = 3.26, min = 3, max = 12), and the children were mostly male (10 males, 58.82%).

Design

This reliability check was conducted to investigate whether the scale captured true or convergent aspects of the child's characteristics. The CAB was answered at the same time-point by both parents, with reference to the same child. Tests consisted of a correlational analysis and a t-test investigating whether parental reports were significantly different.

Results

The correlation of inter-rater reports on the same child was r = .50, *p* = .05 (95% CI: .01 - .08). A paired sample t-test failed to reject the null hypothesis (t (16) = 0.16, *p* = .87,

suggesting differences between mother (M: 26.24, SD: 8.47) and father (M: 26.50, SD: 6.98) did not reach significance.

Study 1d: Longitudinal validity of the CAB

Participants

The sample of study 1d comes from a longitudinal study assessing adult separation anxiety in mothers and their children (n = 46). Adult separation anxiety mirrors that of children, and is characterised by an intense experience of fear and a belief that harm will come to specific attachment figures upon separation (Silove et al., 2010). Half of the mothers in this sample had clinically severe levels of separation anxiety, while the other half were controls. Measures were collected when the mother was pregnant (T1), 3-months after birth (T2), and when the children were 4 (T3). Gender was evenly distributed, with slightly more females (n = 25; 54.35%) than males.

Measures

Child Affective Behaviours (CAB). The CAB is a 12-item measure assessing children's affective behaviours, and includes items assessing the child's proximity-seeking, soothability (capacity to be soothed by his primary caregiver), expressions of love/affection, reception of love/affection, and eye gaze. Items include "My child doesn't like to be hugged" and "My child doesn't respond to my attempts to soothe him/her", assessed on a scale from 1 to 5. The standardised α of the difficulty scale in this sample was .735, which demonstrated good reliability.

Mother-Infant Bonding Scale (MIBS). The MIBS is a measure of maternal feelings and consists of 8 items (e.g. "Loving", "Resentful", "Joyful", etc.) rated on a 4-point scale

ranging from "Very Much" to "Not at All", in which the mother indicates the extent to which she experienced these feelings towards the infant during the "first few weeks" (Taylor, Atkins, Kumar, Adams, & Glover, 2005). The standardised α of the total scale in this sample was .678, showing adequate reliability.

Short Temperament Scale for Infants (STSI). The STSI is a measure of childhood temperament, the version used in this study includes 30 items, rated on a 6-point scale (Sanson, Prior, Garino, Oberklaid, & Sewell, 1987). The STSI has five subscales (6 items each): approach, cooperation, irritability, rhythmicity, and reactivity. Scales were coded such that higher scores in each dimension indicated higher difficulty (i.e. low approach, high irritability), and these were grouped to produce an overall measure of temperamental difficulty. The standardised α of the difficulty scale in this sample was .782, which demonstrated good reliability.

Design

The longitudinal validity of the CAB was tested by assessing the convergence of the scale (collected when children were 4) to measures collected earlier in the child's development. The MIBS, assessing mother-infant bonding, was collected at approximately 3-months after birth. While the STSI was collected when the child was 1 year of age. Analyses consisted of correlations between the total CAB score and the different sub-scales of the two measures of interest.

Results

The CAB, measuring maternal reports of children's affective behaviour problems at age 4, was compared to maternal reports of mother-infant bonding 3-months after childbirth, and to maternal reports of the child temperament when the child was 1-year old. CAB scores

followed the expected pattern of relationships with the child's temperament at age 1 (STSI), and with mother-reported feelings towards the child a few weeks after birth (MIBS). These correlations are presented below in Table 2.4. The overall trend of the data fit the expected direction for an attachment measure. The CAB was either negatively related or showed no relationship to positive MIBS items (Loving, Neutral, Joyful); in contrast, it showed significant positive associations with negative maternal emotions a few weeks after childbirth (Resentful, Dislike, Protective, Disappointed, and Aggressive). It is interesting to note that protectiveness was positively associated with attachment dysfunction as assessed by the CAB.

Table 2.4 Correlations between the CAB and longitudinal attachment-related measures.

Time Period	Measures	4-years of age
		CAB r (*p*)
3-months after childbirth (T2)	Loving (MIBS)	-.20 (.182)
	Resentful (MIBS)	**.31 (.036)**
	Neutral (MIBS)	-.02 (.905)
	Joyful (MIBS)	-.20 (.178)
	Dislike (MIBS)	**.31 (.036)**
	Protective (MIBS)	**.31 (.034)**
	Disappointed (MIBS)	**.32 (.035)**
	Aggressive (MIBS)	**.31 (.037)**
1-year of age (T3)	Approach (STSI)	.17 (.247)
	Cooperation (STSI)	**.32 (.029)**
	Irritability (STSI)	**.49 (.001)**
	Rhythmicity (STSI)	.21 (.165)
	Reactivity (STSI)	-.23 (.122)
	Difficulty – Total Scale (STSI)	**.40 (.001)**

Similarly, total CAB scores were associated with temperament scores as completed by the mother when the child was 1. Note that these scores were coded such that a higher score would indicate higher temperamental difficulty (i.e. high irritability, low cooperation, high difficulty). The "difficulty" subscale, produced by grouping all subscales, was significantly associated with the CAB 3-years later. Longitudinal correlations with the MIBS and the STSI demonstrate divergent validity between CAB scores and related measures, demonstrating these measures assess related but separate constructs.

Study 1e: Concurrent Validity of the CAB

Sample

The sample consisted of 366 families, of which 343 had full CAB data. Families were split into two groups: those recruited from mental health clinics (n = 99), and those from the community (n = 244). Children of families from the clinic (M_{age} = 6.13, SD = 3.36) had a similar age range as those from the community (M_{age} = 5.61, SD = 3.14). However, children from families attending the clinic were more likely to be male (70 males, 74.47%), relative to those from the community (130 males, 53.28%).

Design

The concurrent validity of the CAB was assessed by splitting the sample into clinic and community groups and testing whether real-world differences, such as presenting to a psychological clinic for treatment, translated into meaningful differences on the CAB. Mean differences between groups were compared with a student t-test.

Results

The community sample had an average CAB score of 17.26, with a standard deviation of 5.43; whereas the clinical sample had an average CAB score of 23.67 and a standard

deviation of 7.19. This difference indicated the clinical sample had significantly higher affective dysregulation, as indicated by a student t-test: $t(145) = 7.99$, $p < .001$.

Summary of the CAB

CAB items significantly loaded onto a single factor, with adequate temporal and multi-informant reliability. The validity of the CAB was established by comparing it to longitudinal measures and real-world characteristics, both of which yielded positive results. Demonstrating associations in the expected directions of these measures.

Part 2: The Interview on Critical Bonding Moments

As described above, the attachment literature supports specific predictions regarding the impact of maternal states of mind for the child's healthy socio-emotional development. Studies have found that parental states of mind that translate into subtle behaviour patterns, such as lower contingent responses and decreased maternal sensitivity, tend to be highly time-dependent (Beebe et al., 2010). Although in Beebe's study (2010) temporal dependency is measured on a second-by-second basis, the rapidly-evolving perceptual and cognitive abilities of infants indicate it is likely that parental feelings and behaviours during sensitive periods can be distinctly associated with the emergence of psychopathology. That is, while existing measures such as parent-completed surveys tend to focus on a single time-period, such as infancy (i.e. Maternal-Infant Bonding Scale; MIBS) or on the parent's own general attachment style (i.e. Measure Of Parental Styles, MOPS), no measure (was found that) situated the parents' feelings within a temporal context. The MIBS is brief but unspecific with regards to the timing of the mother's feelings towards her child. It also lacks meta-

cognitive questions around the mother's feelings about the bonding process itself (e.g. "How well do you feel you bonded?"), which might be just as important as experiential emotions (e.g. "I felt engaged with my child"). The ICBM was created with the aim of providing context to parents' feelings about their children, anchoring parents' narratives in specific bonding moments that might elicit strong emotional responses.

The Interview on Critical Bonding Moments (ICBM) is a retrospective assessment of six critical bonding moments for parents: pregnancy, childbirth, the first time the child is taken home, the first few times feeding the child, the first memorable separation, and the first experience of the child's fright. The ICBM probes the parent's state of mind during each of these episodes, by asking about the parents': anxiety, depression, fright, disengagement, and repulsion, as well as their emotion recognition and closeness (when appropriate). Items are worded so as to investigate the parents' feelings towards the child, but when delivering the scale face-to-face it became clear parents answer these questions broadly, regarding their general mood at the specified time. Lastly, the final section of the ICBM contains three questions regarding the parent's self-reported attachment style (using an adapted version of a previously validated scale, Smallbone & Dadds, 1998), as well as general evaluations of their bonding, jealousy, and overall experience during the first six months. The full scale is presented below.

Study 2a: Internal Structure of the ICBM

Sample

The sample for this study is the same as that of study 1a, a large group of parents (n = 366) and their children, who were mostly male (n = 221, 60.38%), and had a mean age of 5.79 years (SD = 3.17, min = 2, max = 16).

Measures

Maternal state of mind during bonding (ICBM). Mothers' narrative about their critical bonding periods were assessed using the Interview on Critical Bonding Moments (ICBM), a retrospective questionnaire investigating how mothers felt during six stages: pregnancy, childbirth, first time cuddling the child at home, first times feeding the child, first separation, and the first memory of the child being frightened. The questionnaire includes seven core dimensions at each stage (Anxiety, Depression, Fright, Disinterest, Aversion, Closeness, and Emotion Recognition [in relevant stages]) judged on a five-point scale. Each stage also includes questions specific to that stage, for example the stage focusing on birth includes items on whether there were complications during birth, and whether birth was a traumatic experience. The full scale is included below.

Design

Participants from the community were recruited at local preschools. Participants from the clinic attended one of our sites for the treatment of behaviour problems, completing the study's measures before treatment began.

ICBM analysis followed a different plan from the CAB, as the focus of this measure was maternal responses to individual items; nevertheless, two grouping strategies are presented here which allow the testing of the scale's internal structure. Given that the same questions are asked at each critical bonding stage, there are two main ways in which ICBM items are grouped: either by combining items from the same stage (e.g. pregnancy), which would yield an overall valence of the parent's state of mind during that period; or by combining the same item across different stages (e.g. anxiety), which would yield an overall anxiety score across several bonding experiences. However, each individual item is important, as they capture different states of mind (at different points in time), each of which

could be uniquely associated with psychopathology. Therefore, the internal structure of the ICBM is not suited to the same tests of internal reliability as the CAB, as item importance varies relative to the research question being pursued.

Results

Psychometric properties for the two grouping methods are summarised in Table 2.5 below. Items are represented by their first three letters (e.g. Anx = Anxiety), and colons indicate a list of items, such that the items Anxiety, Depression, Disinterest, Frightened, and Repulsed are summarised as "Anx:Rep". Numbers indicate the stage for each item, such that Dep1 is Depression at Pregnancy, and Dep5 is Depression during the First Separation.

Table 2.5. Reliability of grouped ICBM items.

Grouping Across Stages

	Item #	Items	Cronbach Alpha (95% CI)	Sample
Pregnancy	6	Anx:Rep, Close	0.82 (0.78 – 0.84)	312
Childbirth	6	Anx:Rep, Close	0.88 (0.86 – 0.9)	312
At Home	7	Anx:Rep, Close, EmoRec	0.89 (0.87 – 0.91)	316
Feeding	7	Anx:Rep, Close, EmoRec	0.88 (0.85 – 0.89)	312
Separation	7	Anx:Rep, Close, EmoRec	0.81 (0.78 – 0.84)	304
Child was Scared	7	Anx:Rep, Close, EmoRec	0.78 (0.75 – 0.81)	289

Grouping Across Dimensions

	Item #	Items	Cronbach Alpha (95% CI)	Sample
Anxious/Calm	6	Anx1:Anx6	0.71 (0.65 – 0.76)	289
Depressed/Happy	6	Dep1:Dep6	0.72 (0.66 – 0.77)	286
Disinterested/Engaged	6	Dis1:Dis6	0.81 (0.77 – 0.84)	284

Frightened/Confident	6	Fri1:Fri6	0.75 (0.69 – 0.79)	288
Repulsed/Attracted	6	Rep1:Rep6	0.80 (0.76 – 0.84)	286
Close	6	Close1:Close6	0.83 (0.80 – 0.86)	288
Emotion Recognition	4	EmoRec3:EmoRec6	0.73 (0.70 – 0.79)	289

As seen in Table 2.5 above, Cronbach alphas for both grouping strategies were high, with the lowest being the accrual of anxiety items across the 6 critical bonding stages (0.71) and the highest being the grouping of all items pertaining to the mother's feelings towards the child the first time she brought the child home (0.89). These results support the grouping of ICBM items to create scales of maternal emotional states at specific moments in time; or to examine maternal feelings across several stages of the child's development.

Interview on Critical Bonding Moments

This set of questions are meant to probe your emotional connection with your child throughout several critical points of your child's development. We will begin with the very early days, when the child was still inside the belly.

Pregnancy

Was this your first child?   Yes   O   No   O
Were there any complications during the pregnancy?   Yes   O   No   O

Please rate the extent to which the statements below reflected your feelings or attitudes towards your unborn child by placing an "X" in the circle that is closest to how you felt at the time:

Anxious	O	O	O	O	O	Calm
Depressed	O	O	O	O	O	Happy
Disinterested	O	O	O	O	O	Engaged
Frightened	O	O	O	O	O	Confident
Repulsed	O	O	O	O	O	Attracted

How stressful did you find pregnancy to be?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

How emotionally close did you feel to your unborn child during this stage?

Very Close	Close	Distant	Very Distant
O	O	O	O

Childbirth

Were there any complications during childbirth?   Yes   O   No   O
Was the experience of childbirth traumatising?   Yes   O   No   O

If yes to either of the above, please explain: _____

Please rate the extent to which the statements below reflected your feelings or attitudes towards your child the first time you held him/her by placing an "X" in the circle that is closest to how you felt at the time:

Anxious	O	O	O	O	O	Calm
Depressed	O	O	O	O	O	Happy
Disinterested	O	O	O	O	O	Engaged
Frightened	O	O	O	O	O	Confident
Repulsed	O	O	O	O	O	Attracted

How emotionally close did you feel to your child during this stage?

Very Close	Close	Distant	Very Distant
O	O	O	O

Now please think back to when you brought your child home for the first time and you were alone, away from strangers and medical staff. The following questions are about intimacy and connection.

First Times You Cuddled Your Child at Home

Please rate the extent to which the statements below reflected your feelings or attitudes towards your child by placing an "X" in the circle that is closest to how you felt at the time:

Anxious	O	O	O	O	O	Calm
Depressed	O	O	O	O	O	Happy
Disinterested	O	O	O	O	O	Engaged
Frightened	O	O	O	O	O	Confident
Repulsed	O	O	O	O	O	Attracted

How easy was it to read your child's emotions at this stage?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

How emotionally close did you feel to your child during this stage?

Very Close	Close	Distant	Very Distant
O	O	O	O

First Times Feeding Your Child at Home

Was your child breastfed, bottle-fed, or both?   _____

Please rate the extent to which the statements below reflected your feelings or attitudes towards your child by placing an "X" in the circle that is closest to how you felt at the time:

Anxious	O	O	O	O	O	Calm
Depressed	O	O	O	O	O	Happy
Disinterested	O	O	O	O	O	Engaged
Frightened	O	O	O	O	O	Confident
Repulsed	O	O	O	O	O	Attracted

How easy was it to feed him/her at this time?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

How easy was it to read his/her emotions?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

How emotionally close did you feel to your child during this stage?

Very Close	Close	Distant	Very Distant
O	O	O	O

For these sections please think about a specific point in time or event. Try to recall what was happening at the time, and how this might have affected your feelings towards your child.

First Separation

How long were you away during this first separation?   _____

How old was your child at this time?   _____

What was the reason behind the separation?   _____

How easy was to read his/her emotions?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

Please rate the extent to which the statements below reflected your feelings or attitudes towards your child by placing an "X" in the circle that is closest to how you felt at the time:

Anxious	O	O	O	O	O	Calm
Depressed	O	O	O	O	O	Happy
Disinterested	O	O	O	O	O	Engaged
Frightened	O	O	O	O	O	Confident
Repulsed	O	O	O	O	O	Attracted

How emotionally close did you feel to your child during this stage?

Very Close	Close	Distant	Very Distant
O	O	O	O

First Time Your Child was Scared/Frightened

How old was your child at this time?   _____

Why was he/she scared/frightened?   _____

How easy was to read his/her emotions?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

Please rate the extent to which the statements below reflected your feelings or attitudes towards your child by placing an "X" in the circle that is closest to how you felt at the time:

Anxious	O	O	O	O	O	Calm
Depressed	O	O	O	O	O	Happy
Disinterested	O	O	O	O	O	Engaged
Frightened	O	O	O	O	O	Confident
Repulsed	O	O	O	O	O	Attracted

How emotionally close did you feel to your child during this stage?

Very Close	Close	Distant	Very Distant
O	O	O	O

These last questions are about your overall parenting over the first six months, and about how you felt or behaved during this time.

<div style="border:1px solid black; padding:1em;">

Overall Parenting

Below are three descriptions of how parents might have felt and behaved towards their child. Please read each description carefully, then rate each one to the extent it describes your parenting style.

A. I've been noticeably inconsistent in my reactions to my child, sometimes warm and sometimes not. I have my own needs and agenda, which sometimes got in the way of my receptiveness and responsiveness towards my child's needs. I definitely love him/her, but haven't always shown it in the best way.

Not at all like me			Somewhat like me		Very much like me	
1	2	3	4	5	6	7

B. I've been generally warm and responsive, I've been good at knowing when to be supportive and when to let my child operate on his/her own. Our relationship is almost always comfortable, and I have no major reservations about it.

Not at all like me			Somewhat like me		Very much like me	
1	2	3	4	5	6	7

C. I've been fairly cold, distant, and rejecting, and not very responsive. I have often felt like my child isn't my highest priority, and that my concerns are elsewhere. I've frequently had the feeling that I would've just as soon not have had my child.

Not at all like me			Somewhat like me		Very much like me	
1	2	3	4	5	6	7

Overall, would you say you felt jealous or resentful of your child during the first six months?

Very Much	Somewhat	Not Really	Not at All
O	O	O	O

Overall, how would you rate this period of your life (first six months after birth)?

Very Positive	Somewhat Positive	Somewhat Negative	Very Negative
O	O	O	O

In general, how well did you feel you bonded with your child during this period?

Very Well	Somewhat	Not Really	Not at All
O	O	O	O

</div>

Study 2b: Temporal reliability of the ICBM

Participants

A small sub-sample of 23 parents – the same sample from study 1b – were tested at two points in time, two months apart, to assess the temporal reliability of the ICBM. This group was drawn from the community sample, had a mean age of 5.13 (SD = 2.47, with ages ranging from 2 to 11), and an even gender distribution (12 males, 52.17%).

Design

The temporal reliability of the ICBM was assessed with the sample from study 1b, which completed the questionnaire two months apart. Parents were aware that they would be asked to complete the ICBM twice. At each time point, parents had a one-week period during which they could submit their responses electronically. Parents were reminded to submit their responses three times within the target weeks, at the start and end of the two-month period. A correlational analysis was conducted to assess the reliability of ICBM dimensions and stages, as well as some illustrative single-item scores.

Results

Parental responses to the ICBM are summarised in Table 2.6 below. The same strategy from study 2a was applied to aggregate ICBM scores into dimensions (e.g. Anxiety, Fright) and stages (e.g. Pregnancy, First Separation). All dimensions yielded high temporal consistency, with anxiety showing the strongest effect (r = .75) and aversion (repulsed – attracted) the weakest (r = .58). Stages showed a similar pattern, albeit with one non-significant correlation between the two time-points. The strongest association was for Childbirth (r = .81) and the weakest for the first time the child was brought home (r = .29),

which did not reach significance (p = .210). Single items tended to show adequate temporal

reliability, with relationships tested ranging from .53 to .16.

Table 2.6. Temporal correlations between a two-month interval

Variable	r (95% CI)	p	N
Dimensions			
Anxiety	.75 (.48 - .89)	< .001	21
Depression	.62 (.25 - .83)	< .001	21
Disinterest	.64 (.28 - .84)	< .001	21
Fright	.63 (.27 - .83)	< .001	21
Repulsed	.58 (.20 - .81)	.01	21
Close	.64 (.29 - .84)	< .001	21
Stages			
Pregnancy	.64 (.28 - .84)	< .001	21
Childbirth	.81 (.59 - .92)	< .001	21
Child Home	.29 (-.17 - .64)	.21	21
Feeding Child	.64 (.29 - .84)	< .001	21
First Separation	.71 (.40 - .87)	< .001	21
First Scare	.66 (.31 - .85)	< .001	21
Single Items (Examples)			
Attachment Security	.53 (.12 - .78)	.01	21
General Bonding	.48 (.06 - .75)	.03	21
Fright (Pregnancy)	.44 (.01 - .73)	.05	21
Disinterest (Feeding)[*]	.16 (-.29 - .56)	.48	21

* Disinterest during feeding was not significantly different
between time-points: t (20) = 0.295, p = .771, mean difference =
0.05.

Study 2c: Concurrent Validity of the ICBM

Sample

The sample consisted of a large group of families (n = 366), of which 327 had ICBM data. Families were split into two groups: those from mental health clinics (n = 92), and those from the community (n = 235). Children of families from the clinic (M_{age} = 6.01, SD = 3.18) had a similar age range as those from the community (M_{age} = 5.62, SD = 3.20). However, children from families attending the clinic were more likely to be male (72 males, 78.26%), relative to those from the community (124 males, 49.6%).

Design

The validity of the ICBM was assessed by splitting sample 1 into clinic and community groups and testing whether real-world differences, such as presenting to a psychological clinic for treatment, translated into meaningful differences on the ICBM. To achieve this, the different dimensions (Anxiety, Aversion, Closeness, Depression, Disinterest, and Fright) were plotted across six stages (Pregnancy, Childbirth, Taking the child home, Feeding the child, First Separation, First Fright), in a line graph (2.4, below). Clinic and community scores were also compared across a subset of items that were specific to individual stages (e.g. Childbirth) or from items on the last page (e.g. "In general, how well did you feel you bonded with your child during this period?"), in a set of bar graphs.

Results

Results are displayed on Graph 2.4 below, in which mean levels are plotted with error bars representing standard errors. Note that the y-axes vary depending on the scores' dispersion for each dimension. Here significant differences were found between clinic and community samples across all dimensions (in at least one stage).
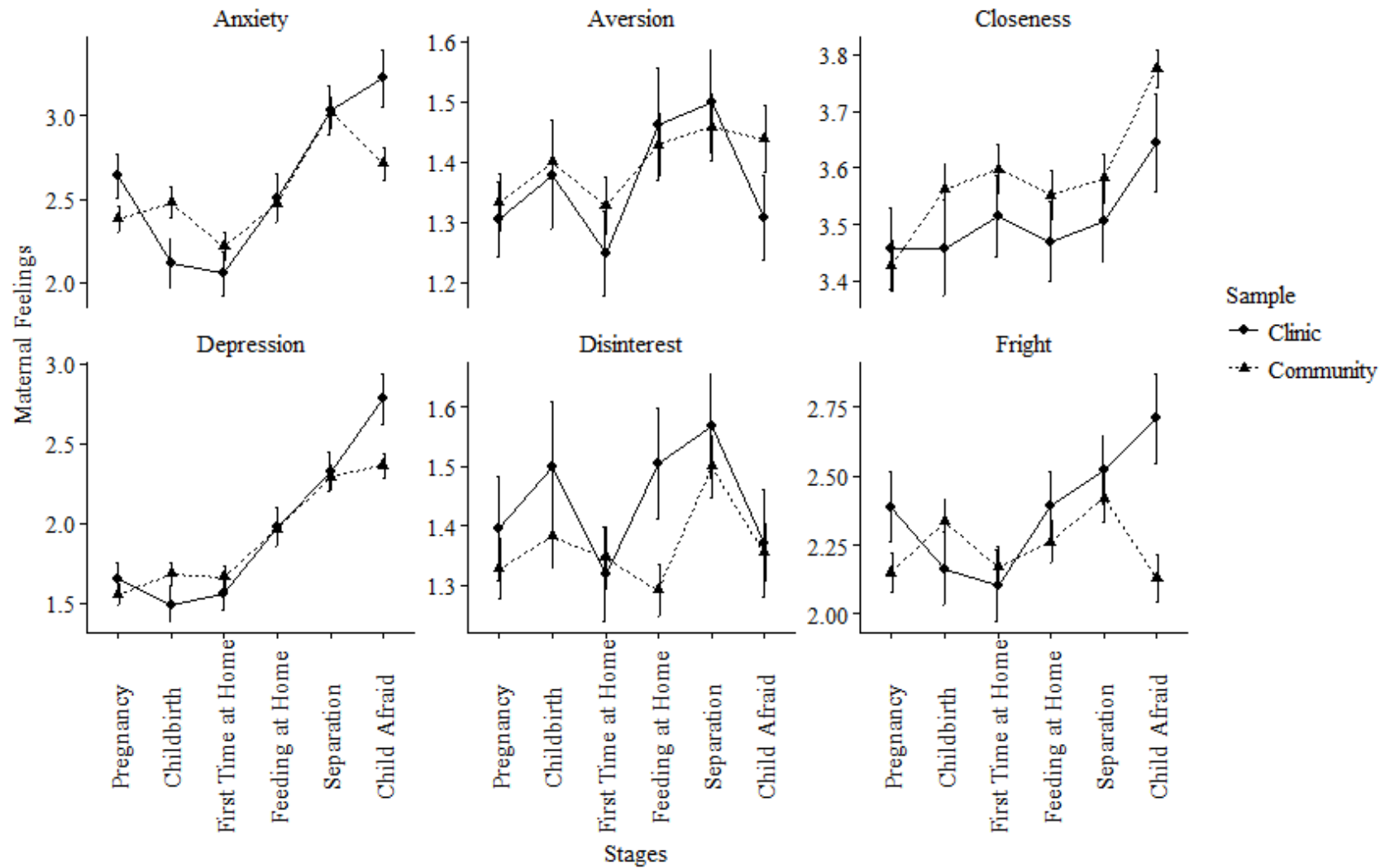
Graph 2.4 Distribution of clinic and community ICBM scores across all stages. Error bars represent standard errors, and scales are arranged such that higher scores are reflective of a higher magnitude of the dimension specified (e.g. Anxiety, Closeness, etc).

Likewise, four of the six stages show differences between clinic and community participants in at least one dimension. The "first time at home" and "separation" stages did not appear to elicit different responses in these two groups. In contrast, maternal reports of the mother's own feelings when their child was afraid were different (for clinic vs. community) in five out of the six dimensions depicted. Pregnancy and childbirth, which also showed differences between groups, only did so across two dimensions.

There were other significant differences between clinic and community samples on other elements of the ICBM. For example, even though there was no difference between community and clinic birth complications, the clinic sample was more likely to report the experience of birth as traumatising. Likewise, even though there were no differences in overall bonding ("In general, how well do you feel like you bonded with your child over this period?"), there were significant differences in self-reported secure attachment, as well as differences in how positive they reported the first six months of their child's life. As seen in graph 2.5, the y-axis changes between the different measures due to differences in the scale for each question (e.g. the bonding item is on a scale of 1-4, but the item for secure attachment has a 7-point scale).
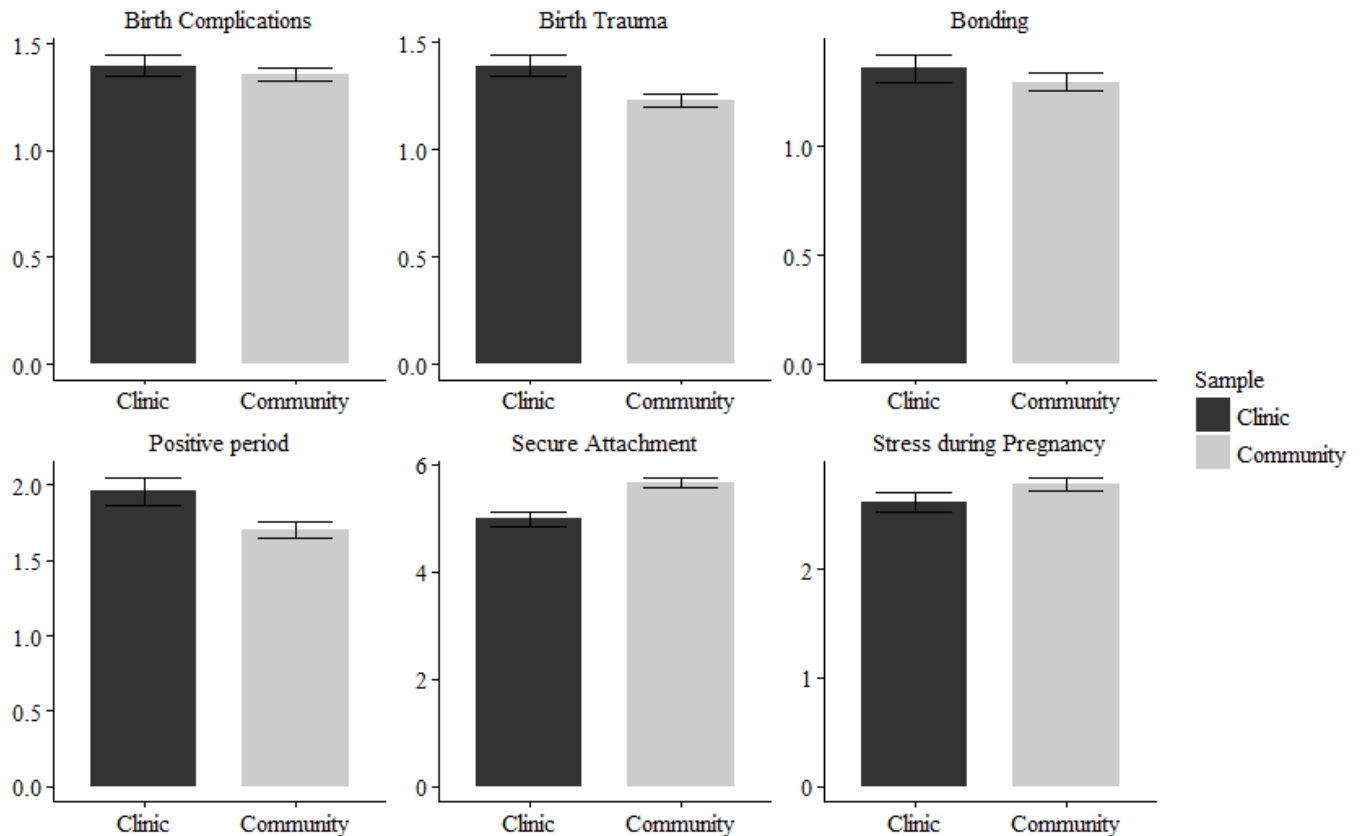
Graph 2.5 Differences between clinic and community ICBM scores. Error bars represent standard errors.

Study 2c: Convergent validity of the ICBM

Sample

The sample for study 2c is the same as that of study 1d. A longitudinal sample of mother-child dyads (n = 47) with either high or normative levels of separation anxiety in the mothers. As mentioned above, gender was evenly distributed, with slightly more females (n = 25; 53.2%) than males. Measures were collected when the mother was pregnant (T1), 3 months after birth (T2), and when the children were 4 (T3). The CAB and ICBM measures were both collected at T3.

Measures

  Edinburgh Postnatal Depression Scale (EPDS). The EPDS is a well-validated measure of depression in mothers (Cox, Holden, & Sagovsky, 1987), and consists of 10 items rated on a 4-point scale. The EPDS was collected when mothers were pregnant (T1) and 3-months after the child's birth (T2). The scale's standardised α at T1 was .827 and .916 at T2, indicating high internal reliability.

  Adult Separation Anxiety Scale (ASA). The ASA consists of 27 items rated on a 4-point scale ranging from "This has never happened" to "This happens very often" (Manicavasagar, Silove, Wagner, & Drobny, 2003), with items such as "Have you suffered from nightmares or dreams about being away from home?". The ASA was collected at T1 and T2. The scale's standardised α at T1 was .915 and .914 at T2, indicating high internal reliability.

  State and Trait Anxiety Inventory (STAI). The STAI is a measure of both transient and dispositional anxiety in adults, it includes 40 items (20 for state and trait each), rated on a 4-point scale ranging from "Almost Never" to "Almost Always". Example items for the trait questions include "I feel secure" and "I am calm, cool, and collected"; state items include "I feel at ease" and "I am presently worrying over possible misfortunes" (Spielberger, Gorsuch, & Lushene, 1970). The STAI was collected at T1 only. Both the Y1 or "State" questionnaire, and the Y2 or "Trait" scale had a standardised Cronbach α of .932.

  Maternal state of mind during bonding (ICBM). Mothers' narrative about their critical bonding periods were assessed using the Interview on Critical Bonding Moments (ICBM), a retrospective questionnaire investigating how mothers felt during six stages: pregnancy, childbirth, first time cuddling the child at home, first times feeding the child, first separation, and the first memory of the child being frightened. The questionnaire includes

seven core dimensions at each stage (Anxiety, Depression, Fright, Disinterest, Aversion, Closeness, and Emotion Recognition [in relevant stages]) judged on a five-point scale. Each stage also includes questions specific to that stage, for example the stage focusing on birth includes items on whether there were complications during birth, and whether birth was a traumatic experience. The ICBM was collected at T3.

Design

The longitudinal validity of the scale was assessed by correlating maternal responses to the ICBM with their responses to items assessing similar constructs 4 years earlier. These analyses were correlational, and attempted to demonstrate the convergence of retrospective measures with mothers' own reports at a similar time-point as that purportedly assessed by the ICBM.

Results

The convergent validity of the ICBM was tested by comparing retrospective responses to the ICBM with maternal reports of the same constructs 4-years earlier. Correlations between scores are presented in table 2.7 below. Variables indexing anxiety at pregnancy: Edinburgh Post-Natal Depression questionnaire (EDS), Adult Separation Anxiety Scale (ASA), and the State and Trait Anxiety Inventory (STAI), were significantly associated with self-reports of anxiety and fright in the ICBM. Interestingly, state, but not trait anxiety was significantly associated with the ICBM's anxiety score, indicating that mothers accurately remembered their mental state at the time, rather than reporting on their general ('trait') anxiety.

Likewise, variables collected 3-months after childbirth (EDS and ASA) were significantly associated with ICBM variables measuring the same constructs. The relationship

between the mother's EDS at T2 followed the expected direction in its association with

ICBM measures of depression during childbirth (r=.23), but was not significant (*p* = .130).

Note also that there are spill-over correlations between items, with the EDS often being

significantly associated with self-reported anxiety on the ICBM. It is likely that correlations

between depression and anxiety reflect real-life comorbidities between these conditions.

Table 2.7. Correlations and p-values between ICBM items (collected when child was 4)
and mood variables (collected during pregnancy/birth)

| Time Period | Measures | 4 years later (ICBM) | |
		Anxiety r (*p*)	Depression r (*p*)
Pregnancy (T1)	Trait Anxiety (STAI)	.25 (.097)	.20 (.187)
	State Anxiety (STAI)	**.42** (.005)	.29 (.054)
	Adult Separation Anxiety (ASA)	**.39** (.008)	**.32** (.032)
	Depression (EDS)	**.34** (.026)	**.30** (.043)
3 Months After Childbirth (T2)	Adult Separation Anxiety (ASA)	**.36** (.030)	.19 (.210)
	Depression (EDS)	**.33** (.017)	.23 (.130)

Discussion

The results above supported the psychometric reliability and validity of the new measurement tools developed for this research. The CAB had good internal, multi-informant, and test-retest reliability. The one-factor structure of the scale, supported by the exploratory principal components analysis, was replicated in the confirmatory analysis, albeit with moderate to poor goodness-of-fit indices. Moreover, longitudinal associations with relevant measures followed expected directions. The ICBM also showed good reliability for grouping items between both stages and dimensions. The concurrent validity of the measure was assessed by comparing whether real-world differences between participants attending a psychological clinic and participants recruited from the community were reflected by their responses to the ICBM. The convergent validity of the measure was further confirmed by comparing longitudinal responses from mothers at pregnancy and shortly after birth with their retrospective reports four years later.

These results are encouraging, but are subject to several limitations. First, a mixed-sample was used as it allowed greater variation between scores and substantial increases in power. However, more targeted sampling would have been better suited to assess the validity of these questionnaires for other clinical populations. Second, most variables used in the study consist of parent-reported questionnaires, whereas behavioural assessments would have provided stronger evidence for our conclusions. To counter this, we attempted to use real-world differences between clinic and community groups to test the validity of the ICBM, but this was not possible with the CAB. These challenges were addressed by building on the study's strengths.

This study used large samples to test the overall reliability and structure of the CAB and ICBM, while using smaller samples to test specific aspects, such as the temporal

reliability of the measure or its convergent longitudinal validity. An example of this approach is the use of maternal reports at pregnancy and childbirth and their comparison to maternal responses to the ICBM 4 years later. The convergence between these scores is a testament of the measures' ability to consistently capture the constructs it is designed to assess. Moreover, these associations were stronger when investigating temporal windows of time such as states relative to more stable trait-like constructs. These findings support our goals of capturing some of the variance in moods and emotions that accompany child development with self-report tools such as the ICBM.

In conclusion, the ICBM and CAB are two new tools for the study of early bonding; where the first assesses maternal feelings towards the child at different critical stages, and the second scores the child's attachment behaviours. These tools could be used to explore the early emergence of interpersonal difficulties common among psychiatric conditions such as schizophrenia and autism. In the next section, these tools are used to predict callous-unemotional traits, testing the specific hypotheses posited by the disorganisation literature regarding the impact of the mother's mental state for the development of socio-emotional disturbance. The intention here is threefold: first, to ascertain whether maternal states of mind (e.g. in particular fear, depression, and disinterest) are associated with CU traits; second, to determine whether the children's affective behaviours are predictive of CU traits; and third, to compare these associations to determine whether they are independent predictors of CU traits.

STUDY 3: MATERNAL FRIGHT, DISINTEREST & INFANT BONDING ARE

ASSOCIATED WITH CALLOUS AND UNEMOTIONAL TRAITS

The results from the second study, presented above, demonstrated the psychometric validity of two tools designed to assess the relationship between early maternal bonding (ICBM) and children's affective behaviours (CAB). This third study set out to test whether maternal states of mind and bonding during critical bonding periods, and children's own affective characteristics, were associated with CU traits. The influence of warmth, sensitivity, and attachment are increasingly recognised as playing an important role for the development of CU traits (Bedford et al., 2017; Pasalich et al., 2011a; Pasalich, Dadds, Hawes, et al., 2012), but it is unclear how these caregiver-led variables interact with the affective characteristics of the child, their constitutional baggage, in the prediction of CU traits. In order to examine the relationship between maternal states of mind, child affective behaviours, and CU traits the aims of the study were formalised into two competing hypotheses.

The first hypothesis stipulates that three maternal variables will be positively associated with CU traits: fear, disinterest, and closeness. A general reading of attachment theory, particularly with regards to attachment disorganisation and the AMBIENCE model (Madigan et al., 2006; Main & Hesse, 1990; Pasalich, Dadds, Hawes, et al., 2012), suggests that more maternal fear during critical bonding moments ought to be associated with CU traits. Similarly, micro-analyses of mother-infant interactions suggest mothers of infants with disorganised attachments are more likely to display a flattened affect, consistent with disinterest by the mother (Beebe et al., 2010). Lastly, the emotional closeness construct was derived from the literature highlighting the importance of warmth for CU traits (Pasalich et al., 2011a), and which maps well onto felt and physical closeness, central for attachment (Bowlby, 1969).

On the other hand, older CU models suggest parents may have less influence than constitutional characteristics (Viding et al., 2009; Viding et al., 2008). Furthermore, findings from study one demonstrated strong inter-generational stability of CU traits between fathers and their children – which was not moderated by either parenting or warmth – and might therefore imply transference beyond what could be modelled socially. The second hypothesis posits that higher dysregulation in children's affective behaviours will be associated with a higher incidence of CU traits, regardless of maternal feelings during early bonding stages.

Method

Participants

Participants consisted of a mixed-sample of 299 children (clinic=65, community=234), who were mostly male (n=175; 58.53%), with an average age of 5.7 (SD=3.24, min = 2, max = 16). Most of the children had one sibling (n = 129), 59 had no siblings, n = 77 had 2 or more siblings, and 34 families did not report sibling numbers. Most mothers reported being married or in a long-term partnership (n = 260), and a smaller number reported being separated, divorced, or single (n = 28). The rest of the mothers did not specify their marital status (n = 11). The sample was well-educated, with most of the sample reporting a tertiary education (n = 238), 38 mothers reporting technical or college-level education, and 14 reporting primary education or below. Mothers were also asked the extent to which their lives had been impacted by depression or anxiety on a scale from 0 (no impact) to 10 (completely impacted), the mean level of impact was 2.96 (SD = 2.91), with 82 mothers reporting no impact and 198 reporting some impact (n = 93 reported an impact of 5 or above). 19 mothers did not answer this question. A similar question regarding substance abuse was asked of the sample, here a majority of mothers reported no impact of substance abuse in their lives (n = 191), and 68 reported some impact (n = 13 reported an impact of 5 or

above). Moreover, 21 of the mothers who reported some problems with substance abuse did not report any problems with depression or anxiety. 40 mothers did not have data for the substance abuse question. Lastly, 21.40% of the sample had high CU traits (UNSW scale greater than 8), as depicted in Graph 3.1 below.
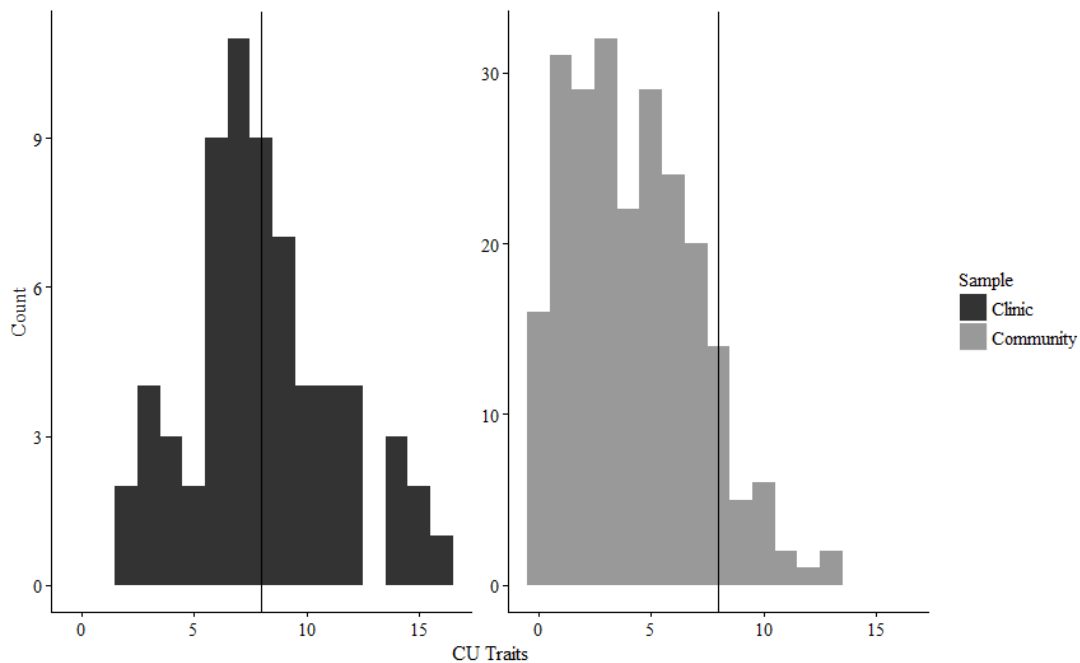
Graph 3.1. Number of children with CU traits in clinical and community subsamples

Participants from the community were recruited from local preschools/schools after participants attended a parenting talk hosted by a member from our team. Clinical participants were referred to the Child Behaviour Research Clinic, following the same process described in study 1. Note there is no overlap with participants from previous studies. Participants from the clinic generally had more demographic risk than those of the community, as displayed in Table 3.1 below, with parents reporting lower educational attainment, higher rates of divorce/separation, and more siblings. As well as parents reporting higher problems with their children, as indexed by higher scores in the Strengths and Difficulties Questionnaire.

Table 3.1 Demographic comparison of clinic and community samples

Variables	Clinic	Community	Comparison
Age (SD)	6.29 (3.24)	5.57 (3.12)	$t = 1.96, p = .051$
Gender	84 males (77.06%)	130 males (52%)	$t = -4.88, p < .001$
	25 females	120 females	
Maternal Education (SD)^	4.46 (0.88)	4.75 (0.62)	$t = -2.95, p = .003$
Paternal Education (SD)^	4.13 (1.01)	4.57 (0.83)	$t = -3.62, p < .001$
Biological Siblings (SD)	1.30 (0.82)	0.94 (0.74)	$t = 3.39, p = .001$
SDQ Total (SD)	18.05 (8.23)	10.47 (5.28)	$t = 8.89, p < .001$
Household	67.1% Lived with both parents	94.4% Lived with both parents	$\chi^2 = 61.76, p < .001$
Primary Caregiver	Mother (40%)	Mother (56%)	$\chi^2 = 19.00, p < .001$
	Both (48.6%)	Both (41.2%)	
Medication	64% No meds	89% No meds	$\chi^2 = 31.75, p < .001$
	12.5% Stimulants	2% Stimulants	
	12.5% Other drugs	4.4% Other drugs	
	6.3% Allergy/asthma	3.6% Allergy/asthma	
Language	90.3% English	85.2% English	$\chi^2 = 1.22, p = .269$
Marriage	73.8% Married/De-facto	92.0% Married/De-facto	$\chi^2 = 27.47, p < .001$
	16.2% Separated	3.6% Separated	
	5.1% Divorced	2.8% Divorced	
	5% Other	1.6% Other	

^ Education was indexed on a 1 – 5 scale: 1 – no formal education; 2 – primary school education; 3 – year 10; 4 – year 12; and 5 – university or technical education.

Measures

Demographics. Self-reported demographic variables were collected along with questionnaire responses. There were differences between the timing of the collection of these variables in the clinic vs. the community. As the demographic details in the clinic were collected as part of the standard admission process, whereas these were collected along with the rest of the data in the community sample.

CU Traits. The measurement of CU traits was performed by using a combination of items from the Antisocial Process Screening Device (APSD; Frich & Hare, 2001) and the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997; Williamson et al., 2014). This measure of CU traits has been well validated in multiple studies (Dadds et al., 2008; Hawes & Dadds, 2007; Kimonis et al., 2015), and yielded more reliable results than the use of the APSD alone.

Child Attachment Behaviours (CAB). The CAB is a 12-item measure assessing child attachment behaviours, and includes items assessing the child's proximity-seeking, soothability (capacity to be soothed by his primary caregiver), expressions of love/affection, reception of love/affection, and eye gaze. Items include "My child doesn't like to be hugged" and "My child doesn't respond to my attempts to soothe him/her", assessed on a scale from 1 to 5, with the following possible responses: "Strongly Disagree; Disagree, Undecided; Agree; and Strongly Agree". The CAB's standardised Cronbach alpha was .880 in this sample. The scale and its validation is included in Study 2.

Maternal state of mind during bonding. Mothers' state of mind was assessed using the Interview on Critical Bonding Moments (ICBM), a retrospective questionnaire investigating how mothers felt during six stages: pregnancy, childbirth, first time cuddling the child at home, first times feeding the child, first separation, and the first memory of the child

being frightened. The questionnaire includes seven core dimensions at each stage (Anxiety, Depression, Fright, Disinterest, Aversion, Closeness, and Emotion Recognition [in relevant stages]) judged on a five-point scale. Each stage also includes questions specific to that stage, for example the stage focusing on birth includes items on whether there were complications during birth, and whether birth was a traumatic experience. The scale and its validation are included in Study 2.

Design and Analysis

Participants from the community answered a questionnaire pack after attending a parenting talk hosted at their local institution (school/preschool). Participants from the clinic answered a similar questionnaire pack (with a larger number of measures) as part of the induction process at the Sydney Child Behaviour Research Clinic. While most measures asked about current concerns, the ICBM is a retrospective measure, and asks participants to think back to several stages of their child's early life, this measure is described in greater detail below.

The analysis consisted of four parts. First, direct associations between maternal bonding variables, children's affective behaviours, and CU traits were assessed using Pearson correlations. Second, CU traits were dichotomised into high and low groups, and mean level data was plotted at each stage with standard error bars, this revealed a number of differences across stages and dimensions, which led us to employ a broader analysis. Third, a Bayesian additive regression tree (BART) model was used to assess the relative importance of all ICBM predictors (Chipman, George, & McCulloch, 2010), the total CAB score, and CU traits. Fourth, findings from the BART model were directly compared with a generalised estimating equation model. Analyses were conducted in R version 3.4.1 and IBM SPSS Statistics version 24.

Results

Part 1. Associations between affective/bonding variables and CU traits

Correlations between the main study variables and demographic variables were analysed using multiple zero-order correlations. Significance calculations accounted for multiple comparisons by using Holmes' corrections, these results are summarised in Table 3.2 below.

Table 3.2 Correlations between demographic variables

Measure	1	2	3	4	5	6	7	8
1 Age	-							
2 Gender (male = 1; female = 2)	.00	-						
3 Maternal Education	-.05	.06	-					
4 Paternal Education	-.01	-.02	**.32**	-				
5 ICBM – Secure Attachment	-.06	.07	-.06	-.08	-			
6 ICBM – Bonding Problems	.08	-.01	-.02	-.04	**.32**	-		
7 CAB – Affective Problems	.15	-.16	-.16	-.04	**-.34**	**-.20**	-	
8 CU Traits	-.05	**-.26**	-.13	.02	**-.27**	**-.18**	**.51**	-

Bolded items indicate significance after applying Holmes correction for multiple comparisons ($p < .001$), except for two relationships: Bonding – CAB ($p = .02$) and Bonding – CU traits ($p = .05$).

Sample size was 298 for all relationships except maternal education (290) and paternal education (286).

Out of the demographic variables tested, only gender was significantly associated with CU traits ($r = -.26$, $p < .001$), with boys being more likely to present with these characteristics. Age, maternal education, and paternal education were all non-significant in their relationship with the main outcome variables. Children's affective behaviour (CAB), in which a higher score indicates higher affective dysfunction, showed a strong positive association with CU traits ($r = .51$, $p < .001$). Two items from the last section of the ICBM,

which assesses general parenting during the first six months of the child's life, also showed significant associations with CU traits. The parent's attachment security ($r = -.27$, $p < .001$), was significantly associated with CU traits, such that there was less incidence of CU traits in cases with high self-reported attachment security. This same relationship was paralleled in maternal reports of general bonding (i.e. "In general, how well did you feel you bonded with your child during this period"; $r = -.18$, $p = .05$), which indicated inadequate bonding was associated with higher levels of CU traits.

Part 2. ICBM differences between high and low levels of CU traits

In order to investigate whether ICBM variables were meaningfully related to CU traits a visual analysis of the data was carried out. CU traits were dichotomised into High (n = 64) vs. Low (234) groups, using a cut-off of 8 in the UNSW scales (a combination of SDQ and APSD items) to indicate a high prevalence of these traits. This cut-off was chosen based on previous publications from our research lab (e.g. Hawes and Dadds., 2005). Next, the six dimensions of the ICBM were plotted, (i.e. anxiety, aversion, closeness, depression, disinterest, and fright) which are common to all six stages (1: pregnancy, 2: childbirth, 3: first time bringing the child home, 4: first few times feeding the child at home, 5: first separation, 6: first time the child was frightened). Results from this analysis are displayed below in Graph 3.2. Note that the y-axes were allowed to vary freely, and their range is dependent on the variation in average scores for each group (High vs. Low CU) in each of these dimensions. The x-axis is a numerical representation of the six stages mentioned above, it is worth noting that while stages 1-4 are chronological in order, the same is not necessarily the case with stages 5 and 6.
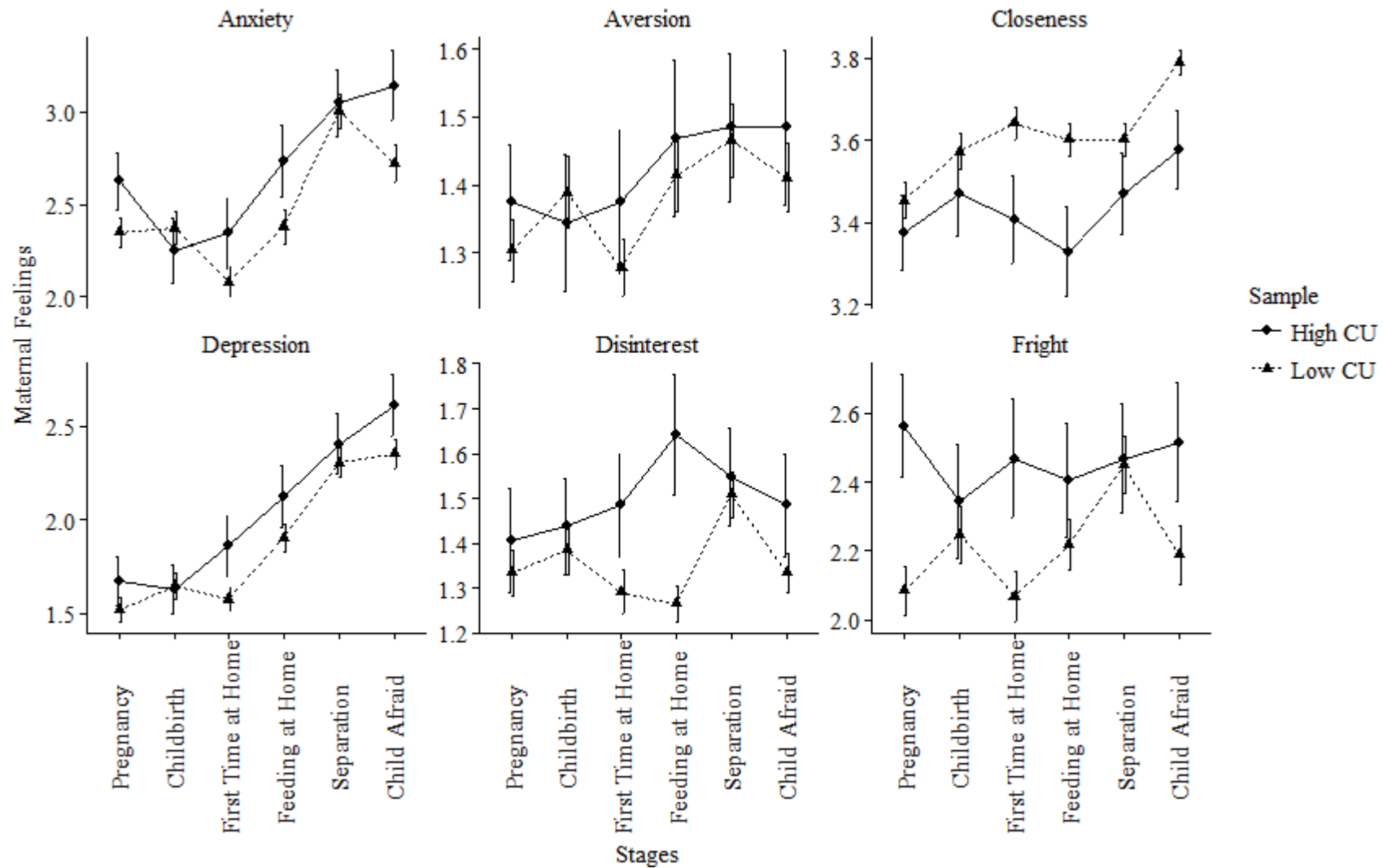
Graph 3.2 Variation in critical bonding moments across groups high and low in CU traits.
Error bars represent the standard error at each point.

Plotting the data in Graph 3.2 revealed differences between groups in five of the six dimensions (there were no significant differences in aversion at any of the six stages), and in four stages from the possible six (there were no significant differences between dimensions in either childbirth or the first separation). The largest differences between groups were in perceived closeness to the child while feeding, in disinterest while feeding, and in fright during pregnancy. This analysis supported the hypothesis that there were meaningful differences in critical bonding moments between groups high and low in CU traits; in fact, it suggested more differences than those hypothesised (in the domains of fright and closeness). Therefore, it was decided to directly compare all variables by using a Bayesian model able to incorporate all predictors in a single analysis. This was a data-driven bottom-up approach, that would allow the comparison of our specific hypotheses to all relationships manifested in the mother's ICBM data, while also taking into account the relationship between CU traits and the child's affective behaviours.

Part 3. Bayesian additive regression tree model comparing mother and child variables

In order to compare which of our two measures (the CAB and the ICBM) were most strongly associated with the early emergence of CU traits, a machine learning algorithm was used: Bayesian additive regression trees (BART), which generated multiple decision trees to estimate which variables were most likely to predict a specified dependent variable (Chipman et al., 2010). For example, a single decision tree might generate a rule that: "If closeness at pregnancy is below 2, and the CAB score is above 15, then there's a high chance that the child will have high CU traits". BART generates a large number of these decision trees, and then samples the predictor variables to determine which of these were most often associated with the DV. Due to its Bayesian iterative nature, this method can use many predictors and is well-suited to manage multicollinearity among them.

In an exploratory analysis, BART model was generated using all ICBM items common to at least four stages (seven dimensions in total: anxiety, aversion, closeness, depression, disinterest, fright and emotion recognition), as well as the total CAB score and the child's gender. This resulted in a total of 42 predictors (independent variables), with a sample size of 298. It is important to note that as the analysis was exploratory, we were less interested in model fit, and more interested in which variables were repeatedly associated with CU traits. The BART model built 250 trees at burn-in and 1000 post. samples, the in-sample statistics (L1 = 615.05; L2 = 1993.1) indicated large differences between the burn-in and testing samples. The model fit was poor, as indicated by an RMSE of 2.59 (the RMSE should be below 0.8 for a model to be considered a good fit for the data), and a pseudo-R^2 = 0.395 indicated the model accounted for about 40% of the variance in CU traits (indicating over-fitting), as well as the inclusion of strong predictors of the outcome variable. A more thorough assessment of the model assumptions is included in Appendix B. The results from the variable importance analysis are presented in graph 3.3. and discussed below.
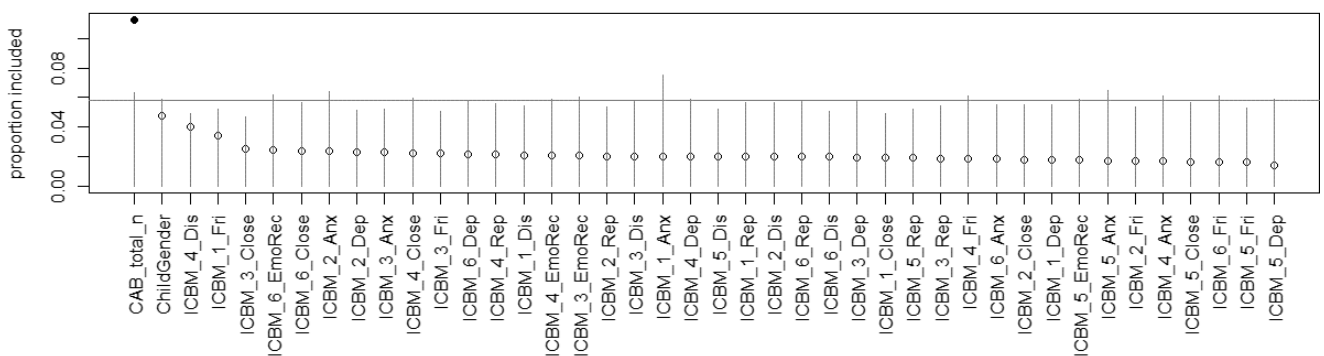
Graph 3.3 Relative importance of variables included in the BART model
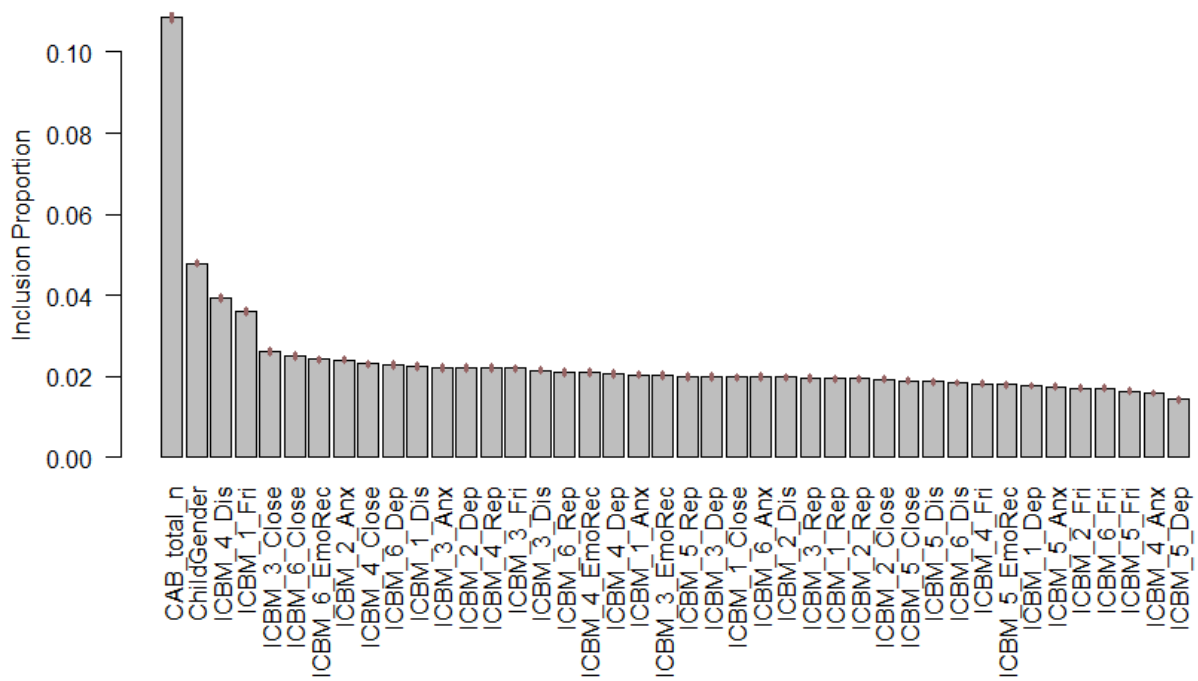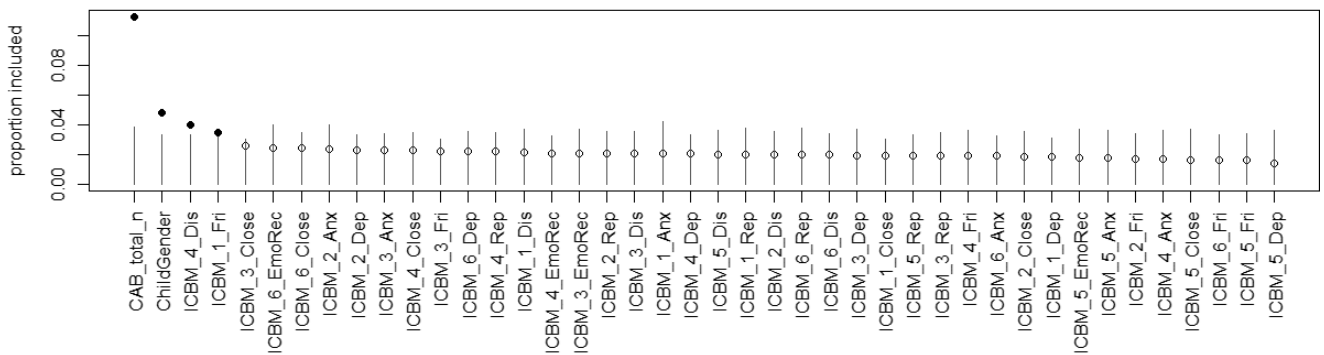
The variable importance analysis in graph 3.3 suggested between 1 and 4 predictors of CU traits, these were: the CAB, the child's gender, the mother's disinterest while feeding, and the mother's fright during pregnancy. The table is divided into three sections, the uppermost section displays predictors ordered by the likelihood that these are included in decision trees, as estimated by averaging estimates across 100 BART replicates. The x-axis of this table includes a bar for each predictor included in the model, the ICBM variables are indexed by both a number (1-6) indicating the stage, and a shortened name (e.g. Anx for Anxiety, Rep for Aversion, and EmoRec for Emotion Recognition) indicating the dimension, such that variable ICBM_4_Dis refers to Disinterest during the 4th stage (Feeding). The second and third tables, generated using a different permutation procedure (which is why the order of some predictors changes), indicate the likelihood that these predictors should be included in a model predicting CU traits. The middle table indicates results based on a local procedure, and supports the inclusion of all four variables mentioned above; while the bottom table, using simulated max and standard error procedures, suggests only the CAB should be used in predicting CU traits. These results can be further analysed by investigating whether the removal of a particular predictor would significantly influence the covariance of other predictors included in the BART model, and lower the pseudo R^2 of the analysis. Covariance importance tests were significant for the CAB ($p < .001$), the child's gender ($p < .001$), and disinterest during feeding ($p = .02$), but were not significant for fright during pregnancy ($p = .23$). These results indicate that the majority of the pseudo-R^2 variance was accounted for by the top three predictors. A more detailed discussion of covariance importance tests is included in Appendix B.

Part 4. Direct comparison of the best predictors (mother and child) of CU traits.

Having narrowed down the number of ICBM dimensions to two, a linear regression

model was carried out using the child's gender, affective behaviours (CAB), the two

predictors derived from the BART analysis (disinterest during feeding; fright during

pregnancy) and the general predictor (from the last page of the ICBM) that was most strongly

associated with CU traits (attachment security). Results from this regression model are

presented below in table 3.3. Multicollinearity among predictors was assessed using variance

inflation factors, none of which indicated high multicollinearity. Outliers were screened for

using studentised residuals, of which no cases survived Bonferroni correction.

Table 3.3 Regression model predicting CU traits

Predictors	β	b	SE	t	*p*
Intercept	-	2.42	1.14	2.13	.034
Gender	-.18	-1.25	0.33	-3.79	< .001
ICBM – Secure Attachment	-.08	-0.18	0.11	-1.59	.112
ICBM – Disinterest at Feeding	.09	0.42	0.22	1.87	.063
ICBM – Fright at Pregnancy	.13	0.40	0.15	2.70	.007
CAB – Affective Problems	.42	0.21	0.03	7.97	< .001

$F(5, 292) = 28.58$, $p < .001$; Adjusted $R^2 = 0.32$. β represent standardised coefficients, and b
refers to unstandardised coefficients, with standard errors (SE) calculated based on b values.

The model significantly predicted the outcome variable ($F(5, 292) = 28.58$, $p < .001$),

and accounted for approximately 32% of the variance in CU traits. Gender and CAB were

significantly associated with the DV, with boys being more likely to exhibit CU traits ($β = -$

$.18$; $p < .001$). As above, higher affective dysregulation in the CAB was associated with a

higher incidence of CU traits ($β = .42$; $p < .001$). From the three ICBM variables, only fright

at pregnancy reached significance ($\beta = .13$; $p = .007$), with disinterest at feeding having marginal strength ($\beta = .09$; $p = .063$). The direction of these effects indicates that higher disinterest and fright, at their respective stages, was associated with a higher score in the CU trait variable.

Discussion

Results suggested novel early emotional markers associated with the emergence of CU traits. The first hypothesis postulated associations between maternal fright, closeness to the child, and perceived bond strength with CU traits. From these, maternal fright (during pregnancy) showed a significant association with CU traits. Two other maternal variables showed strong associations with CU traits: the mother's self-reported attachment style, and her disinterest while feeding the child. The second hypothesis suggested that the child's affective profile would be associated with CU traits regardless of maternal variables. Indeed, the strongest predictor of CU traits in this sample was children's affective behaviour scores, which had a standardised coefficient more than three times larger than the strongest maternal predictor ($\beta_{CAB} = .42$; $p < .001$; $\beta_{fright} = .13$; $p = .007$).

Part 1. Hypothesised maternal predictors of CU traits

Retrospective assessments of maternal feelings and bonding showed significant associations with the emergence of CU traits. These associations were specific to maternal dimensions at specific stages in time. There were several differences in early bonding experiences between children with high vs. low CU traits (see Graph 3.2); however, only two of these observations appeared to be reliable predictors of CU traits across analyses: fright during pregnancy and disinterest while feeding the child at home.

The ICBM variable most strongly related to CU traits was fright during pregnancy. This result was surprising, but it offers an interesting reinterpretation of the traditional aetiological models of disorganisation which, as mentioned in the introduction, posit fright and frightening maternal behaviours as central to the intergenerational transmission of trauma. Children with elevated CU traits have been linked with characteristics that should protect them from these kinds of behaviours (e.g. less attention to the eyes, less likely to recognise fear). Yet the finding that pre-natal fright is associated with the emergence of CU traits presents an interesting reconciliation of these two seemingly contradictory characteristics. That is, the mother's frailty and fright could signal a specific kind of developmental risk that is likely to result in socio-emotional disturbance. However, the mechanism through which this fright is transmitted might not be maternal expressions of emotion; but rather through alterations in the foetal environment and related cascading effects such as hormonal imbalances or epigenetic reprogramming. This interpretation is supported by similar differences in anxiety at pregnancy between groups high and low in CU traits, but is not devoid of challenges.

There are two methodological features precluding a straightforward interpretation of the findings regarding fright. First, the wording of the item refers to "feelings or attitudes towards your unborn child"; however, as we guided parents through the questionnaire it became clear that they were answering these questions with regards to their general mental state at the time. This is a reasonable course of action given that it is difficult to know what the question is about if the instructions are followed literally (e.g. What does feeling "confident" towards an unborn child imply?). It is difficult to determine exactly how mothers interpreted the question; however, the measure's high reliability suggests that most parents answered in a similar way.

A second, but related point, is concerned with the object of the reported fear. Among the many reasons a mother might experience fear there may be contradictory sentiments, for example: one mother may be afraid she will not be able to provide adequate care for her child, while another may be afraid she will act upon her desire to hurt her child. This challenge is somewhat ameliorated by the third point. The dimensional nature of the scale, and the use of "confidence" as the opposite of fear, casts fear as a general lack of confidence, rather than as a directed fear per se. Therefore, it is likely that mothers were referring to a general lack of confidence in dealing with their unborn child. This is supported by two pieces of evidence: (a) the highest correlation between pregnancy dimensions was that between fear and anxiety (r = .61, $p < .001$) – although fear correlated significantly with all items from the pregnancy stage; (b) the means for both high and low CU participants were closer to "Confident" than they were to "Frightened". Nevertheless, the parents' interpretation of the question was not directly tested. In order to clarify the role of fear at this stage it is important for future investigations to incorporate directed questions allowing mothers to elaborate on their fears, as well as physiological responses likely to index fear (e.g. cortisol, pupil dilation, etc.). Although there are important methodological issues with this measure of fear, its consistency with previous models associating fear to attachment disorganisation introduces a novel research target in the study of early socio-emotional difficulties and the emergence of CU traits.

The second predictor showing a strong association with CU traits was the mother's attachment style, in a relationship indicating that less attachment security was associated with more CU traits. In a sense, this is similar to the strength of the mother-infant bond included in the first hypothesis. Indeed, both the mother's perception of her bond ("In general, how well do you feel you bonded with your child over this period?") and her attachment security showed significant associations with CU traits (r = -.18 for bonding; r = -.27 for attachment

security). It is likely that these findings are associated with the findings from study 1, suggesting that maternal warmth can ameliorate the risk for developing CU traits, which has also been found in other studies (Bisby, Kimonis, & Goulter, 2017; Waller et al., 2015). Despite this association, attachment security did not emerge as a significant predictor in the final regression model (β = -.08, p = .112). The measure of attachment used in the study had important limitations: it was a single-item measure (bonding strength was also a single item), and relied on the mother's ability to reflect on her own attachment style. It is likely that this lack of self-reflection was responsible for null findings between attachment ambivalence/avoidance and CU traits.

Part 2. Emergent maternal predictors of CU traits

An unexpected predictor of CU traits was the mother's disinterest while feeding the child at home. The mother's disinterest was the strongest ICBM predictor of CU traits in the Bayesian analysis, and showed the largest gap between high and low CU traits in the visual analysis; however, it was marginally non-significant in the final regression model. Feeding, and in particular mothers' approach to breastfeeding, has been of historic importance for psychology – perhaps most notably in Melanie Klein and Don Winnicott's work around object-relations in the early stages of life, in which the infant's relationship to their mother's "breast" is seen as pivotal for their later socio-emotional development[3]. These theories, some of which inform the work of Main and Hesse (1990), suggest that a mother's disengagement

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[3] There is little evidence in support of some of these claims, such as those regarding infant mentalisation. Also, the work around maternal care and breastfeeding has drawn strong criticism from feminist authors who rightly critique gendered and unrealistic expectations. Winnicott softens this rhetoric considerably, by acknowledging that feeding need not necessitate the "breast", and developing the concept of the "good-enough" mother.

from the process of breastfeeding is likely to elicit anxiety in the child. For example, in p. 38 of On the Theory of Anxiety and Guilt (1948), Klein comments:

"In my view these two main sources of the infant's fear of loss can be described as follows: one is the child's complete dependence on the mother for the satisfaction of his needs and the relief of tension. […] The other main source of anxiety derives from the infant's apprehension that the loved mother […] is in danger of being destroyed."

Winnicott also mentions anxiety (e.g. when discussing the concept of an environment-mother) but is broader in his claims that:

"As a result of success in maternal care there is built up in the infant a continuity of being which is the basis of ego-strength; whereas the result of each failure in maternal care is that the continuity of being is interrupted by reactions to the consequences of that failure, with resultant ego-weakening […] associated with pain of psychotic quality and intensity." (p. 52, Winnicott, 1960, The theory of the parent-infant relationship. In: The maturational processes and the facilitating environment: Studies in the theory of emotional development 37-55. London: Karnac, 1990.) on Girard (2010), Winnicott's foundation for the basic concepts of Freud's metapsychology.

The experience of anxiety by the infant is consistent with aetiological models of disorganisation, but it is less clear how these can be integrated into the emergence of CU traits. It is possible that the infant develops CU characteristics as a defence from this experiential anxiety, but it is notable that anxiety itself is largely antithetical to the CU construct. Both an excess and a lack of emotion from the infant could be associated with the mother's disinterest. Overly-emotional children presenting with repeated colic and crying have been associated with the development of maternal postnatal depression (Vik et al., 2009). Likewise, lethargy in infants and delayed motor development have been associated

with infants at risk of schizophrenia, in a process termed "pandysmaturation" (McNeil, Fish, and Schubert, 2011), albeit the effects of infant hypoactivity on maternal responses have not been studied.

This raises similar challenges to those discussed above for maternal fear. Although the mothers' disinterest itself appears to be associated with the emergence of CU traits, it is beyond the scope of this article to examine whether disinterest preceded the infant's psychopathology or was a result from the infant's own aberrant behaviour. Alternatively, the disinterest might not be associated with the development of CU traits through the mothers' interactions with the child, but rather through a conferring of genetic risk predisposing the infant to be disengaged from emotional stimuli. Yet only disinterest at feeding approached significance in predicting CU traits, and this relationship was not maintained across all stages; hence, it is likely disengagement represented a situational rather than constitutional maternal characteristic. A different challenge to this measure, also akin to that discussed for fear at pregnancy, is that the mean scores tended to be closer to the opposite anchor of the scale: engagement (rather than disinterest). Therefore, a lack of engagement might not imply disinterest as much as disengagement. However, these constructs are likely similar, and explanations for the construct of disinterest are likely to correspond well with disengagement. So far we have discussed both ICBM predictors and their relationship to CU traits, but the relationship between the child's own characteristics and their CU traits was the strongest of the associations studied.

Part 3. Child predictors of CU traits

In line with the second hypothesis, the questionnaire assessing child affective behaviours (CAB) showed a very strong association with CU traits, outperforming other known predictors such as gender. These results provide support for investigations on the early

emergence of CU traits. As discussed above, this questionnaire incorporated four aspects of the attachment and affective literature: eye-gaze, receptiveness to and demonstrations of love, physical proximity, and soothability. Some of these features, such as eye-gaze, have been previously investigated in relation to CU traits. For example, the relationship between emotion-recognition deficits and CU traits has been localised to eye-gaze deficits in behavioural studies (Dadds et al., 2011; Dadds et al., 2006), but had not been investigated through self-report questionnaires. Likewise, CU traits had been associated with parental warmth (Pasalich et al., 2011b), and a lack of empathy in children (Dadds et al., 2009), but it was not evident that parents perceived these children as less warm, or less receptive to warmth. The addition of these interpersonal difficulties to the CU nosology lends support to the possibility that temperamental characteristics of children are related to the emergence of CU traits.

However, the evidence is insufficient to claim that affective behaviour dysregulation in children originates in the children themselves and not their parents. Given the analysis is cross-sectional we cannot claim that one variable caused or preceded the other. Notably, if the sample is stratified by age (by splitting the sample into three groups: 2-3, 4-7, 7-16), the relationship between the child attachment behaviours and CU traits remains significant for all three bands.

Second, since parents rated both the child's affective behaviours and the children's CU traits it is possible that both of these measures suffer from attributional biases. To account for this correlations between the child's affective behaviours and other variables indexing children's mental health problems (anxiety, hyperactivity, anti-social behaviour, and CU traits) were examined. All relationships were statistically significant, with the strongest association seen in the relationship between affective behaviours and CU traits (anxiety: $r = .30$, hyperactivity: $r = .40$, anti-social behaviour $= .46$, CU traits: $r = .51$).

Third, items indexing pro-sociality in the SDQ questionnaire, which make up part of the UNSW CU scale, can be similar to child affective items. This is most obvious in item 17, "kind to younger children", which is similar to the CAB's item 8 "when others are nice to my child he/she responds with love and kindness". This is the only item of the CAB that is related to unspecified "others" who are not an attachment figure, and was included in order to generalise the child's behaviour to other potential caregivers. Moreover, the CAB could be thought of as a targeted version of the SDQ, one that is specific to the child's attachment figures. Theoretically this distinction is important, as the child's enactment of prosocial sentiments with peers and outside the family may be dissimilar from their interactions with their attachment figures. Finally, as discussed above, the CAB is strongly associated with CU traits when other measures of CU traits are used (such as the ICU).

In conclusion, this study found associations between CU traits early in life and children's affective behaviours, as well as with maternal fear during pregnancy, and a non-significant relationship with disinterest during breastfeeding. The instruments revealed new relationships between CU traits and maternal feelings situated within a narrow temporal context (fright at pregnancy; disinterest while feeding). As well as providing support for growing evidence suggesting affective dysfunction is strongly associated with CU traits early in life. As the study is cross-sectional it precludes our ability to establish causal pathways between the variables of interest; however, these associations suggest a role for both the social environment and the child's constitutional/temperamental characteristics in the emergence of CU traits. As the most important problem with this analysis was the cross-sectional nature of the sample, the following study was conducted using the same tools in a longitudinal sample.

STUDY 4: CRITICAL PERIODS ASSOCIATED WITH CALLOUS UNEMOTIONAL TRAITS IN A LONGITUDINAL SAMPLE

Having previously established that retrospective maternal reports of fright at pregnancy and disinterest during feeding, together with children's affective profiles, were associated with CU traits, this study set out to replicate and validate these relationships in a longitudinal sample. More specifically, this study determined whether earlier reports of the same constructs, collected using different measurement tools, also demonstrated the same specific prospective associations to CU traits. This validation enables a better comparison of child and maternal processes associated with CU emergence.

The study is structured in four parts, the first of which is a cross-sectional replication of findings from Study 3 showing that maternal fright at pregnancy, disinterest while feeding, and child's affective behaviours were associated with CU traits. This replication involves a smaller group of individuals and a different measure of CU traits, the Inventory of Callous Unemotional traits (ICU), which has been well-validated in the literature (Hawes, Byrd, et al., 2014; Kimonis et al., 2015; Kimonis, Frick, Skeem, et al., 2008). This replication was conducted to corroborate findings from the larger sample in Study 2, as the next sections of this study rely on the assumption that the previous associations would hold across samples. The first hypothesis (A) was that maternal fright during pregnancy, maternal disinterest while feeding, and children's affective dysregulation would all be positively related to CU traits. This hypothesis is graphically depicted in the topmost third of figure 4.1.

The second part of the study addresses the measurement-invariance of the constructs described above. Retrospective reports are known to suffer from mood-contagion and memory-deficits, yet these limitations tend to be exaggerated (Brewin, Andrews, & Gotlib, 1993), indeed, it was recently shown that retrospective reports of childhood maltreatment

identified a unique group – that differed from that identified from prospective reports – and which had an increased vulnerability to psychopathology (Newbury et al., 2018). Study three used retrospective reports, anchored by specific interpersonal events, to gauge mothers' states of mind. This study seeks to confirm these reports by linking maternal retrospective reports, collected when the participating children were 4, to prospective reports collected earlier (pregnancy, three months after birth, at 1 year of age). As it was not possible to capture the same constructs at the same specific points in time assessed by the ICBM, relatively similar constructs were used. For example, the ICBM item of fear at pregnancy was linked with earlier reports of depression, state anxiety, and worry ("In the last 12 months have you experienced any major worries or stressors?") which might be related through a fear of the future (depression), situational fear (anxiety), or acute stress (worry). Disinterest while feeding was linked to breastfeeding ("Are you currently breastfeeding your baby?"), breastfeeding problems ("Have you experienced difficulties breastfeeding?"), depression, and bonding-difficulties (using the Mother-Infant Bonding Scale; MIBS); as disinterest was thought to be related to disengagement from the act of breastfeeding, disengagement caused by the stress of breastfeeding (breastfeeding problems), a generalised disinterest as manifest in anhedonic responses (depression), or a reflection of bonding problems. Lastly, children's affective behaviours, collected with the CAB at age 4, were taken to be associated with prior measures of temperament (Short Temperament Scale for Infants; STSI) and attachment (Strange Situation Procedure: SSP). The relationship between child affect and temperament was posited as they both capture constitutional characteristics of the child, and the relationship between affect and attachment involves the measurement of similar constructs – a manner of relating to an attachment figure.

Specifically, the second section includes tests of the three hypotheses (B) depicted at the centre of figure 4.1. That fear at pregnancy, assessed retrospectively with the ICBM, will

be significantly correlated with anxiety, depression and worry, collected during pregnancy; disinterest during breastfeeding, assessed retrospectively with the ICBM, will be significantly correlated to depression, breastfeeding, and breastfeeding- and bonding-difficulties collected when children were 3 months old; lastly, that children's affective behaviours, collected at age 4 using the CAB, will be significantly associated to children's early temperament and attachment collected at age 1.

The third part of the study sets out to test whether successful associations posited in part two would predict CU traits longitudinally. For example, if fear at pregnancy (retrospectively collected with the ICMB) was significantly correlated with anxiety, depression, or worry (as reported during pregnancy), the third section tested whether these earlier measures of anxiety, depression, or worry would successfully predict CU traits 4 years later. If no associations were found between retrospective and prospective reports, it was assumed that these variables were measuring different constructs, and their relationship with CU traits was not tested. The intention of this analysis was to replicate the highly specific relationships uncovered in the third study by using similar measures collected at the precise points in time that had been recalled by mothers when answering the ICBM. This aim led to the hypothesis that: (C) when conditions from part two are satisfied (for example, if child temperament is significantly associated to children's affective behaviours) there will be a positive relationship between prospective variables (in this example, child temperament) and CU traits. These hypotheses are represented by the bottom third of figure 4.1.

The fourth part of the study explored interactions between maternal and child variables, testing the hypothesis that interactions would be better predictors of CU traits than either child or maternal variables alone. Hypothesis D is not illustrated in Figure 4.1. Taken together, these four sections investigated whether the relationships uncovered in the previous study could be replicated in a different sample with a longitudinal design. By using different

measures to assess the same constructs (i.e. maternal fright during pregnancy, disinterest while feeding, and children's affect), and by examining their relationship to CU traits, this study provides robust evidence on specific parent and child factors related to emergent psychopathology.
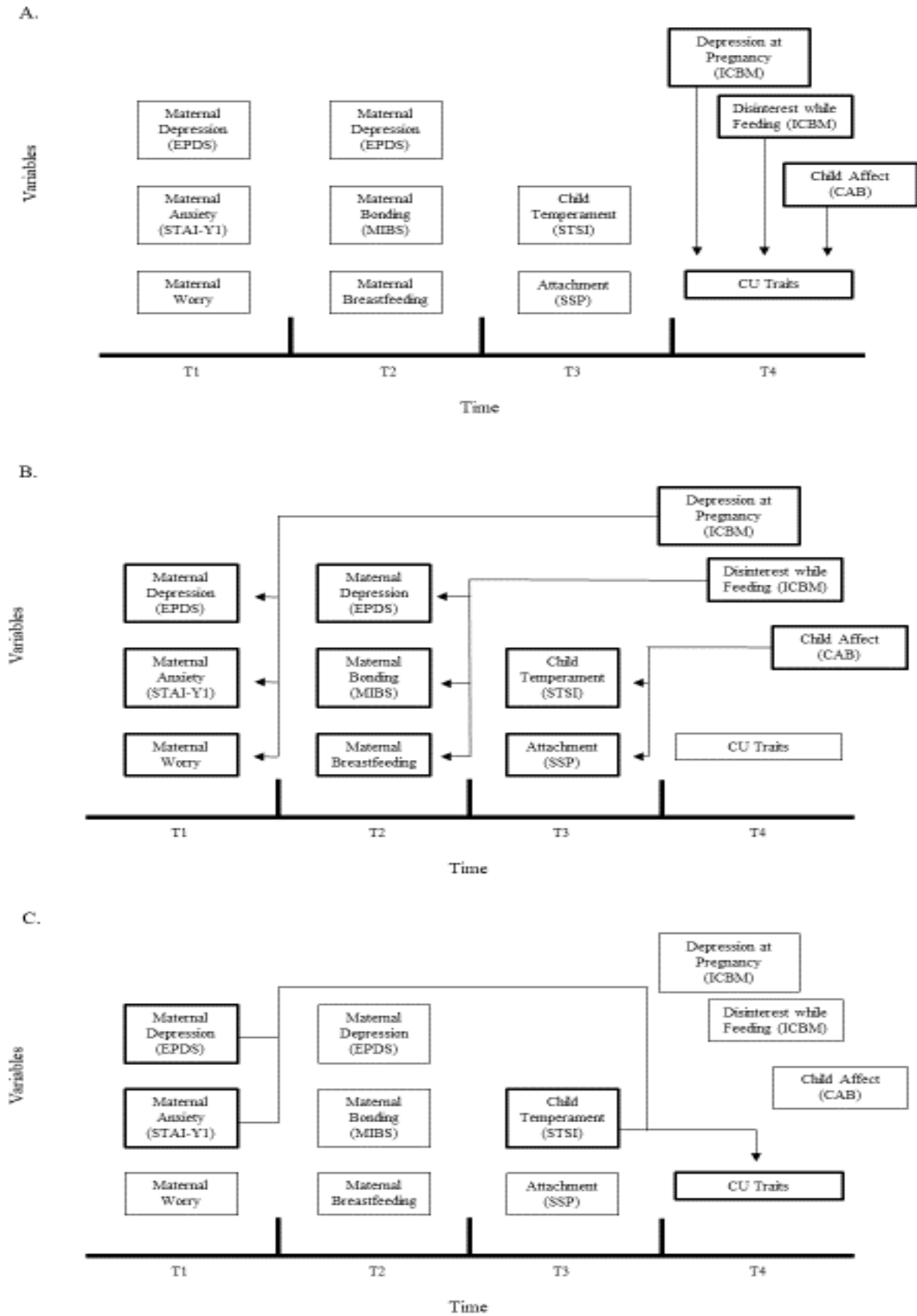
Figure 4.1. Graphical depiction of the three hypotheses of study 4.

Methods

Participants

The original sample of the study (T1) consisted of 127 families recruited during a hospital visit for a pregnancy check-up (from a total of 668 women assessed), half of which had been classed as having clinical levels of separation anxiety: a score of 22 or above in the Adult Separation Anxiety Questionnaire (Manicavasagar et al., 2003). Mother-child dyads were then assessed longitudinally over a four-year period: T1 – pregnancy, T2 – approximately 3 months post-partum, T3 –1 year, and T4 – 4 years. At each assessment point dyads completed a battery of self-report questionnaires and at later time points they completed behavioural measures of socio-emotional development, such as the Strange Situation Procedure. This sample was recruited to assess the impact of maternal separation anxiety on children; however, the questionnaire battery at the fourth time-point included the ICU, allowing the investigation of CU traits in dyads recruited for their emotional difficulties.

Inclusion criteria dictated participants should be over 18 years of age at the expected time of delivery, speak English, have less than 38 weeks of gestation, and be pregnant with a single infant. Sample size declined from 127 at T1, to 117 at T2, and 105 at T3. At the time of the present study, 49 families had participated in the T4 follow-up. Additionally, the study excluded children with an autism diagnosis (as confirmed by the mother) or who were assessed as being at risk of developmental delay with the Denver II interview, this reduced the final sample by three children, from 49 to 46 dyads.

In the final sample of 46 mothers, 25 mothers (54.3%) had been classed as having high separation anxiety at T1, and 21 were controls – indicating no difference in the distribution of anxious mothers between time-points. The sample was not divided by the presence of anxiety, as the overall distribution of anxiety approached normality, and all tests

were performed on the whole (46 dyads) sample. Mean maternal age, education, and ethnicity are included in Table 4.1 below, along with child gender, and average age at each time point.

Table 4.1 Descriptive statistics of the sample

Variables	N	Mean	% of sample	Min	Max	SD
High Separation Anxiety	25	-	54.3	-	-	-
Maternal Age (T1)	46	33 years	-	23	50	5.98
Education						
Primary/Secondary Education	14	-	30.4	-	-	-
Technical Education or Some College	12	-	26.1	-	-	-
Tertiary and Above	20	-	43.5	-	-	-
Ethnicity						
Caucasian	25	-	54.3	-	-	-
Asian	11	-	23.9	-	-	-
Arab	4	-	8.7	-	-	-
Indian	3	-	6.5	-	-	-
Pacific Islander	3	-	6.5	-	-	-
Child Gender (females)	28	-	60.9	-	-	-
Child Age (T1)	46	22.17 weeks	-	10	38	6.95
Child Age (T2)	46	3.37 months	-	2.1	7.4	0.92
Child Age (T3)	46	12.72 months	-	11.5	14.8	0.73
Child Age (T4)	46	4.26 years	-	4.01	4.87	0.23

Minimum values (min), maximum values (max), and standard deviations (SD) use the same units as those in the Mean column.

Measures

Measures were organised around each time point at which they were collected.

T1. *Edinburgh Postnatal Depression Scale (EPDS).* The EPDS is a well-validated measure of depression in mothers (Cox et al., 1987), and consists of 10 items rated on a 4-point scale. The EPDS was collected when mothers were pregnant (T1) and 3-months after the child's birth (T2). The scale's Cronbach alpha was .827 at T1.

State and Trait Anxiety Inventory (STAI). The STAI is a measure of both transient and dispositional anxiety in adults. It includes 40 items (20 for state and trait each), rated on a 4-point scale ranging from "Almost Never" to "Almost Always". Example items for the trait questions include "I feel secure" and "I am calm, cool, and collected", while state items include "I feel at ease" and "I am presently worrying over possible misfortunes" (Spielberger et al., 1970). Only the state scale was used in the analysis (Cronbach alpha: .932), as it was the most theoretically relevant given the study's focus on the temporal specificity of the anxiety.

Worry/Depression: Along with demographic questions regarding ethnicity, date of birth and education there were three items designed to capture the mother's worry/depression during the year of pregnancy. The worry item read: "In the last 12 months have you experienced any major worries or stressors?", to which participants responded dichotomously (Y/N). A further question queried the type of worry/stress suffered: Financial difficulties, Relationship worries, Loss or death, Housing changes, Other. The item about depression read: "Since the pregnancy have you been anxious or depressed for more than two weeks?", to which participants gave a dichotomous (Y/N) response.

T2. *Edinburgh Postnatal Depression Scale (EPDS).* See T1, note that at T2 the scale's Cronbach alpha was .916.

Mother-Infant Bonding Scale (MIBS). The MIBS is a measure of maternal feelings and consists of 8 items (e.g. "Loving", "Resentful", "Joyful", etc.) rated on a 4-point scale ranging from "Very Much" to "Not at All", in which the mother indicates the extent to which she experienced these feelings towards the infant during the "first few weeks" of its life (Taylor et al., 2005). Items were grouped such that a higher score indicated more bonding problems. The scale's Cronbach alpha was .678.

Breastfeeding: Along with demographic questions there were two items about maternal breastfeeding. The first item read: "Are you currently breastfeeding your baby?", to which participants responded in one of six categories which specified the type of foods being consumed by the child. This variable was re-coded binomially to compare mothers who were breastfeeding to those that were not. A further question asked participants: "Have you experienced difficulties breastfeeding?". As before, participants would select between five categories: "Yes I have but I am continuing to breastfeed"; "Yes I have and it was recommended that I stop breastfeeding"; "Yes I have so I decided to stop breastfeeding"; "No I have not experienced any difficulties breastfeeding"; and "No I have not experienced any major difficulties breastfeeding". These categories were collapsed onto a binomial variable.

T3. *Short Temperament Scale for Infants (STSI).* The STSI is a measure of childhood temperament. The version used in this study includes 30 items, rated on a 6-point scale (Sanson et al., 1987). The STSI has five subscales (6 items each): approach, cooperation, irritability, rhythmicity, and reactivity. Scales were coded such that higher scores in each dimension indicated higher difficulty (i.e. low approach, high irritability), and these were

grouped to produce an overall measure of temperamental difficulty. In this sample the scale had a Cronbach alpha of .786.

Strange Situation Procedure. Upon infants' third attendance to the lab they performed the strange situation procedure with their mothers and a research assistant (Ainsworth, Blehar, Waters, & Wall, 1978). The strange situation consists of a series of episodes of separation and reunion from the primary attachment figure, some of which are carried out in the presence of a stranger (interpersonal threat). For a recent paper providing further detail on the structure of the SSP, see Smith, Woodhouse, Clark, and Skowron (2016). The videos from these interactions were coded by an attachment expert, Dr. Elizabeth Carlson (Carlson, 1998). Inter-rater reliability with a second expert, performed on 20 videos, yielded an agreement of 80%. Both raters were blind to the purpose of the study. Ratings from the SSP produced a continuous disorganisation rating, as well as a categorical variable designating the attachment styles of the infants (e.g. B4, B2 = secure; A2 = avoidant; D = disorganised). For the purposes of the current analysis the categorical variable was recoded binomially into secure (i.e. B) and insecure (i.e. A, C, and D) groups.

T4. *Child Attachment Behaviours (CAB)*. The CAB is a 12-item measure assessing child attachment behaviours, discussed previously in study two. The measure's Cronbach alpha in this sample was .735.

Interview on Critical Bonding Moments (ICBM). The ICBM is a retrospective questionnaire investigating how mothers felt during different critical bonding moments. The ICBM is described fully in study two.

Inventory of Callous-Unemotional Traits (ICU). The ICU is a parent-reported and well-validated measure of CU traits in children (Kimonis et al., 2016; Waller & Hyde, 2017b). This study used the 12-item coding of the ICU (Hawes, Byrd, et al., 2014), which has

been found to yield reliable results. Items on the ICU are scored on a scale ranging from 0 (Not at all true) to 3 (Definitely True), and include two subscales: callous (e.g. "Seems cold and uncaring to others") and uncaring (e.g. "Tries not to hurt other's feelings" – reverse scored). The Cronbach alpha of the full scale yielded a reliability of .831.

Analytic Plan

The analysis contained three stages, in parallel to the stages described in the introduction. All analyses were carried out in the full sample, such that "separation anxiety" and "control" participants were collapsed together. Analyses from the first section examine whether results from study three could be replicated. This was achieved first by a correlational examination of associations between maternal fright during pregnancy, maternal disinterest during feeding, child affective behaviours, and CU traits; as well as a generalised linear regression model (GLM) predicting CU traits, which is robust to non-normality in the dependent variable. These analyses addressed hypothesis (A), that maternal fright during pregnancy, maternal disinterest while feeding, and children's affective dysregulation were all positively related to CU traits, such that higher fright/disinterest/affect dysregulation would be associated with higher levels of CU traits.

The second hypothesis contained three parts, all of which were tested through correlational analyses (B): fear at pregnancy, assessed retrospectively with the ICBM, will be significantly correlated with anxiety, depression and worry, collected during pregnancy; disinterest during breastfeeding, assessed retrospectively with the ICBM, will be significantly correlated to depression, breastfeeding, and breastfeeding- and bonding-difficulties collected when children were 3 months old; and children's affective behaviours, collected at age 4 using the CAB, will be significantly correlated to children's early temperament and attachment collected at age 1.

Third, where the correlations hypothesised above were significant, the earlier variables (i.e. anxiety, depression, and worry during pregnancy; breastfeeding, depression, bonding difficulties, and breastfeeding difficulties during feeding; and attachment and temperament at 1) were used to predict CU traits at age 4 with a GLM, in a test of the third hypothesis: (C) that there will be a positive relationship between prospective variables (for example, child temperament) and CU traits, such that higher early dysregulation in maternal and child variables will be associated with a higher levels of CU traits. As depicted in figure 4.1. The fourth part of the study used two GLMs to test whether interactions between maternal and child variables were better predictors of CU traits compared to maternal or child variables in isolation (hypothesis D). All analyses were carried out in IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, N.Y., USA).

Results

1. Replicating cross-sectional relationships with CU traits

Study 3 supported the prediction of CU traits by maternal fear at pregnancy and disinterest while feeding (ICBM), as well as the child's affective behaviours (CAB). Correlations between these variables, and a general linear regression model are presented below in table 4.2 and 4.3 respectively.

Table 4.2 Correlations between CAB, ICBM, and CU variables

Measure	1	2	3	4	5	6
1 ICU – Total	-					
2 ICU – Callous	.86**	-				
3 ICU – Uncaring	.83**	.43*	-			
4 Child Affect Dysregulation (CAB)	.61**	.57**	.46**	-		
5 Maternal Fear at Pregnancy (ICBM)	-.24	-.21	-.20	.03	-	
6 Maternal Disinterest at Feeding (ICBM)	.23	.19	.20	.04	.12	-

* Asterisks indicate significance at $p < .010$, double-asterisks indicate significances at $p = .001$ or below.

As seen in Table 4.2, both subscales of the ICU (callous/uncaring) correlated significantly between themselves and with the total scale. Likewise, the child's affective dysregulation (CAB) was strongly associated to callous/uncaring sub-scales, and showed similar moderate to large correlations with the total scale. ICBM variables showed small correlations with the CU scale, neither of which reached significance (Fear: $r = -.24$, $p = .106$; Disinterest: $r = .23$, $p = .145$). In response to these findings, only the total score of the ICU was used.

Table 4.3. Regression model predicting mother-rated CU traits using concurrent maternal reports (CAB/ICBM)

Variables	β	S.E.	95% Confidence Interval	*p*
Intercept	-.03	.11	-.25; .18	.765
Child Affect Dysregulation (CAB)	.60	.13	.35; .85	< .001
Fear at Pregnancy (ICBM)	-.28	.13	-.54; -.14	.039
Disinterest at Feeding (ICBM)	.25	.12	.02; .48	.032

An omnibus test of the fitted model vs. an intercept-only model yielded a $X^2 (3, 39) =$ 28.01, $p < .001$. β represent standardised coefficients.

Table 4.3 shows the results of a generalised regression model in which the total scale of the ICU was predicted by the CAB's total scale, as well as ICBM (fear at pregnancy and disinterest during feeding) items. All three items significantly predicted CU traits, with the CAB scale as the strongest predictor (β = .60; $p < .001$). These findings replicate prior results from study two. However, in contrast with previous results, the association between fear and CU traits was negative (β = -.28, $p = .039$), indicating that less fear (i.e. more confidence) at pregnancy was associated with higher levels of CU traits.

2. Longitudinal associations between independent variables.

This section tests whether the constructs assessed at age 4 correlated with measures assessing related constructs which had been collected at earlier points in time. That is, the three parts of hypothesis B were tested by examining correlations between fear at pregnancy, disinterest during feeding, and children's affective behaviour; to prospective variables: anxiety, depression, worry; depression, breastfeeding, breastfeeding difficulties and bonding difficulties; children's early temperament and attachment. Results are displayed in Table 4.4 below. The first third of the table, under the heading "Fear at Pregnancy", compares this

ICBM item to variables collected when mothers were pregnant (testing hypothesis B). As seen below, retrospective fear at pregnancy is significantly associated with self-reports of depression and anxiety (EPDS: $r = .50$, $p < .001$; STAI Y1: $r = .47$, $p = .001$), indicating that retrospective fear was positively associated with self-reported anxiety and depression at pregnancy. Correlations between fear and dichotomous variables assessing mental health prior to pregnancy – as measured by either significant worries/stressors ($r = -.06$, $p = .686$) or periods of depression/anxiety ($r = -.11$, $p = .477$) – were not significant. Note that both of these are coded such that $1 = $ Yes and $2 = $ No.

The middle section of Table 4.4 displays correlations between disinterest while feeding and variables collected when children were approximately 3 months old ($M = 3.37$). Here, no correlations were significant, indicating that disinterest during feeding was not captured by the mother's mental health (anxiety and depression), her bonding with the infant, whether she was breastfeeding at the time, or whether she had experienced problems during breastfeeding. Considering these results, it was decided to ignore variables from T2 as they were unlikely to adequately represent the construct captured by "disinterest".

Table 4.4. Correlations between predictors and longitudinal variables

Fear at Pregnancy (ICBM)	r	*p*	Time
Depression (EPDS)	.50	<.001	T1
State anxiety (STAI-Y1)	.47	.001	T1
Worries/stress in the past 12 months? (Y/N) *	-.06	.686	T1
Depressed/anxious for 2+ weeks in the past 12 months? (Y/N)	-.11	.477	T1

Disinterest While Feeding (ICBM)			
Depression (EPDS)	-.04	.809	T2
Bonding (MIBS)	-.02	.908	T2
Breastfeeding? (Y/N)	-.04	.814	T2
Breastfeeding problems? (Y/N)	.06	.700	T2

Child's Affective Dysregulation (CAB)			
Attachment disorganisation (SSP – Continuous) *	-.01	.977	T3
Attachment security (SSP – Secure/Insecure) *	-.22	.161	T3
Temperamental Difficulty (STSI)[+]	.40	.006	T3

* The relationships between these variables and CAB/ICBM variables is explored further in Appendix C.

+ The relationship between temperament and the CAB had been previously reported as part of study three.

The last section of Table 4.4 compares children's affective profile as assessed by the CAB, and other variables assessing the child's emotional responses. The association between attachment disorganisation (as coded from the SSP) and the CAB was non-significant and approached zero ($r = -.01$, $p = .977$). There was also a small, non-significant relationship between attachment security (coded 1 = secure; 2 = insecure) and child affective dysregulation ($r = -.22$, $p = .161$), indicating that children categorised as having a secure attachment were rated by parents as having high affect dysregulation. Lastly, there was a moderate and significant relationship between the child's temperament and the CAB ($r = .40$, $p = .006$), in which more temperamental difficulty was associated with higher levels of affective dysregulation.

Hypothesis B was partially confirmed, such that maternal fright and child affect were significantly associated with antecedents measuring related constructs: fear at pregnancy (measured retrospectively) was linked to depression and anxiety collected at pregnancy; likewise, children's affective behaviour at 4 was associated with their temperament at 1. However, the other parts of this hypothesis were not corroborated in the sample (e.g. associations between the CAB and the SSP). The next step predicted CU traits using longitudinal, rather than cross-sectional, variables.

3. Longitudinal predictions of CU traits

Having established that maternal fright during pregnancy and children's affective behaviours were significantly correlated with depression/anxiety and child temperament collected at earlier points in time, the third hypothesis was tested to assess whether these longitudinal predictors could themselves predict CU traits at age 4. Variables associated with the mother's fear during pregnancy (depression and state anxiety at T1) and the child's affective behaviours (temperament at T3) were correlated with CU traits, then used to predict CU traits in a generalised regression model (GLM). Results are displayed in Tables 5 and 6 below. As displayed in Table 4.5, only the child's temperament was significantly correlated with CU traits, with depression and state anxiety both showing negligible or small associations. However, depression and anxiety were significantly correlated ($r = .57$, $p < .001$).

Table 4.5. Correlations between total ICU scores and prospective predictors

Measure		1	2	3	4
1	ICU – Total	-			
2	Depression at Pregnancy	-.09	-		
3	State Anxiety	.16	.57***	-	
4	Temperamental Difficulty	.48***	.10	.15	-

$^\Delta$ indicates $p < .10$; * indicate $p < .05$; ** indicate $p < .01$; *** indicate $p < .001$.

As seen in table 4.6 the child's temperament, as measured through the STSI, was the only significant predictor of CU traits at age 4 ($\beta = 0.47$; $p = .001$). Maternal self-reported depression (EPDS) was of borderline significance ($\beta = -0.28$; $p = .058$). This association had the same direction as that between "fear during pregnancy" and CU traits. That is, *less* depression was associated with higher levels of reported CU traits. However, as the correlation between depression and CU traits was very small, it seems likely that the correlation between anxiety and depression is behind the borderline significance of depression. In this sense, hypothesis C was only confirmed for the child's temperament (assessed at age 1), this demonstrated that temporal predecessors of cross-sectional variables could successfully predict CU traits.

Table 4.6. Regression models predicting mother-rated CU traits using significant predictors from part 2.

Variables	β	S.E.	95% Confidence Interval	p
Intercept	.01	.13	-.24; .25	.973
Depression (EPDS)	-.28	.15	-.56; .01	.058
State anxiety (STAI-Y1)	.25	.19	-.12; .62	.184
Temperamental Difficulty (STSI)	.47	.14	.21; .74	.001

An omnibus test of the fitted model vs. an intercept-only model yielded a $X^2 (3, 41) = 15.34$, $p = .002$. β represent standardised coefficients. BIC: 131.37.

As results indicated a relationship between temperament measured at 1 and CU traits at age 4, and correlational analyses from study 2 suggested that temperament was also associated with affective behaviours (results from table 2.4 are shown as part of row 7 in table 4.7). Therefore, the relationship between these three variables was unpacked in a post-hoc analysis examining which temperamental dimensions were most strongly correlated with affective dysregulation and the emergence of CU traits. The results are displayed below in table 4.7.

Table 4.7. Correlations between total ICU scores, CAB, and temperamental dimensions

Measure	1	2	3	4	5	6	7
1 ICU – Total	-						
2 STSI – Approach	$.29^\Delta$	-					
3 STSI – Rhythmicity	.11	$.33^*$	-				
4 STSI – Cooperation	$.36^*$	$.44^{**}$	$.31^*$	-			
5 STSI – Reactivity	-.19	-.22	-.10	-.19	-		
6 STSI – Irritability	$.54^{***}$	.59	$.45^{**}$	$.51^{***}$	-.05	-	
7 CAB – Total	$.61^{***}$	.17	.21	$.32^*$	-.23	$.49^{**}$	-

$^\Delta$ indicates $p < .10$; * indicate $p < .05$; ** indicate $p < .01$; *** indicate $p < .001$.

The STSI measures five temperament dimensions: approach, rhythmicity, cooperation, reactivity, and irritability. These dimensions are coded such that a higher score represents more problems in that domain (e.g. higher score in the cooperation dimension represents less cooperation; whereas a higher irritability score represents a more irritable child). As displayed in Table 4.7 above, the strongest correlation between temperament and CU traits was found for the irritability dimension ($r = .54$, $p < .001$), followed by cooperation ($r = .36$, $p = .013$), and approach ($r = .29$, $p = .054$). The correlation between irritability and CU traits was higher than the correlation between the total STSI difficulty scale and CU traits

($r = .48$, $p = .001$). Lastly, correlations between the full temperament scale and child affect were high ($r = .40$, $p = .006$), and as with CU traits, were strongest for the irritability subscale ($r = .49$, $p = .001$). Given this relationship, the irritability dimension of temperament was used in part of the next analysis.

4. Exploratory interactions between maternal and child-level variables

As there were prospective relationships between maternal states of mind during pregnancy and child variables, interactions between these were analysed in two generalised linear regression models. The results from the analyses are displayed below in Table 4.8. Results consistently supported child affect and temperament as the main predictors of CU traits, both cross-sectionally (model 1) and longitudinally (model 2) – both βs equalled .59. In contrast, maternal variables were weaker predictors across both models. The interactions between maternal anxiety during pregnancy and children's characteristics were significant across both models, suggesting that mothers high in anxiety who had children with high levels of constitutional risk were more likely to classify these children as high CU at age 4. This analysis should be interpreted with caution, however, as the relatively low number of participants limits the model's power in examining interactions. Bayesian information criteria (BIC) were also included in Table 4.8, which show that both models were relatively equivalent in their fit of the data. BICs were also lower than those of the regression model in table 4.6, suggesting there was no over-fitting given the number of variables included.

Table 4.8. Regression models using mother- and child-level variables in interaction.

Variables	β	S.E.	95% Confidence Interval	*p*
Model 1 – Child Affect				
Intercept	-.02	.11	-.24; .21	.894
Depression (EPDS)	-.24	.14	-.52; .03	.083
State anxiety (STAI-Y1)	.18	.11	-.03; .39	.088
Child Affect (CAB)	.59	.14	.32; .86	<.001
CAB*EPDS	-.17	.19	-.55; .21	.388
CAB*STAI-Y1	.18	.07	.05; .31	.008
Model 2 – Child Irritability				
Intercept	-.001	.12	-.23; .23	.996
Depression (EPDS)	-.36	.11	-.57; -.14	.001
State anxiety (STAI-Y1)	.20	.10	-.01; .40	.059
Child Irritability (STSI)	.59	.12	.35; .82	<.001
STSI*EPDS	-.33	.14	-.61; -.05	.023
STSI*STAI-Y1	.43	.15	.14; .73	.004

Model 1: An omnibus test of the fitted model vs. an intercept-only model yielded a X^2 (5, 39) = 26.66, *p* < .001. BIC: 127.66. Model 2: An omnibus test of the fitted model vs. an intercept-only model yielded a X^2 (5, 39) = 26.59, *p* < .001. BIC: 127.73 β represent standardised coefficients.

Discussion

This study investigated whether maternal fear at pregnancy, disinterest while feeding, and child affective behaviours were associated with the emergence of CU traits in a longitudinal sample. As in study 3 these results suggested that the children's characteristics were the strongest predictors of CU traits, with maternal constructs showing inconsistent results. In this study, children's affective behaviours and their irritable temperament both significantly predicted CU traits. Likewise, the interaction between maternal anxiety during pregnancy and children's characteristics were significant predictors of CU traits.

Replicating cross-sectional relationships with CU traits

The first hypothesis postulated that CU traits would be predicted by maternal fear at pregnancy, maternal disinterest while feeding, and child affect in a cross-sectional analysis. Results partially supported an association between maternal disinterest while feeding and affective dysregulation, such that higher levels of these were related with higher levels of CU traits. In contrast, the relationship between maternal fear at pregnancy and CU traits had the opposite direction to that expected: namely, lower fear during pregnancy was associated with *more* CU traits. These results are consistent with intergenerational transmission of fearless temperament, as has been suggested by genetic and behavioural studies (Dadds et al., 2011; Larsson et al., 2006). However, this finding was inconsistent with previous results, which had suggested that higher fear during pregnancy was associated with more CU traits (Study 3). Overall, the inconsistent direction of the association between fear at pregnancy and CU traits makes it difficult to determine which of these narratives, if any, might be correct. Research in this area has been largely lacking, as parenting is often examined in terms of harshness or warmth (Pasalich, Dadds, Vincent, et al., 2012), but research has not explored parental psychopathology in detail. A small exploratory study found that mothers from a group of

aggressive children with high CU traits were more likely to report low self-esteem than non-aggressive controls (Priddis, Landy, Moroney, & Kane, 2014). However, less is known regarding the emergence and structure of anxiety in children with CU traits (Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999).

Longitudinal associations among IVs.

Given cross-sectional results were replicated, the second part of the study sought to assess whether maternal fright during pregnancy, disinterest while feeding, and child temperament could be associated with maternal mood and child temperament longitudinally. There was partial support for an association between fear at pregnancy, assessed retrospectively at age 4, with anxiety and depression, but not worry (which were assessed during pregnancy). This indicated that retrospective reports of fear were related to what mothers were experiencing at the time, but not necessarily their worries over the preceding 12 months. Fear at pregnancy was associated with maternal depression and state anxiety (as opposed to trait anxiety), possibly suggesting associations with a negative state of mind at a specific point in time, rather than a preoccupation with particularly stressful events at the time – as there was no relationship between worry and fear.

In contrast, disinterest during feeding, assessed at age 4, was not correlated with any of the measures collected when children were approximately 3 months of age. This result is subject to several interpretations. Disinterest during feeding was not related to either depressive states (depression or bonding-difficulties), or problems exclusive to breastfeeding, an explanation supported by groups engaged in dyadic micro-analysis, which argue that communication and contingency deficits cannot always be traced to more general cognitive problems (Beebe et al., 2010). However, this does not explain the initial association between disinterest and CU traits. Rather, it may be the case that the 3-month window occurred too

late in development, as the ICBM item suggests answering the feeding section in relation to the "first few times feeding your child at home". It may also be the case that the disengagement reported by mothers falls well outside of a pathological threshold, and is experienced by mothers as a mild disinterest, rather than a total disconnect from their children (and hence clinical scales of anxiety and depression might not be sensitive to these differences). This suggestion seems to be supported by the distribution of the disinterest measure, in which most participants reported maximum engagement at the time of breastfeeding (the scale, which was reverse-scored, had a mode of 5 and a mean of 4.8, with the maximum value being a 5). Therefore, while the association between disinterest during feeding and CU traits was replicated across both studies, it is unclear exactly what is being captured by this item.

There was also evidence for an association between child temperament and affect, but not between affect and the strange situation procedure. This supports our conceptualisation of temperament and child affect as two measures capturing constitutional characteristics of the child. Instead, the SSP captured children's responses to a specific attachment-figure when faced with an attachment threat (i.e. separation). As previous studies had shown a strong association between attachment disorganisation and CU traits (Bohlin et al., 2012; Pasalich, Dadds, Hawes, et al., 2012), a similar association was expected here with children's affective dysregulation. However, both of the studies cited above assessed attachment through narrative tasks in small sample sizes, whereas the only study on the association between CU traits and attachment using the SSP found a very small association between CU traits and disorganisation (Willoughby et al., 2014b). Moreover, these studies assessed attachment in a period between $3 - 6$ years, and it is possible that later attachment patterns had stabilised into internal working models and were better able to generalise to other constructs. Finally,

attachment and CU traits were found to be unrelated in this study, this was an unexpected finding that is discussed in Appendix C in greater depth.

Longitudinal predictions of CU traits.

Having established that fear during pregnancy and child affect (both measured at 4) were associated with maternal depression and anxiety (for fear during pregnancy) and child temperament (for child affect), these constructs were then used to predict CU traits longitudinally. Child temperament, measured when children were 1, was a significant predictor of CU traits at age 4. In contrast, neither maternal depression or anxiety (measured during pregnancy) significantly predicted CU traits. Interactions between child- and maternal predictors found that maternal anxiety interacted with children's affect or temperament in the prediction of CU traits. Although these findings support the notion of composite risk for CU traits derived from both the mother's state of mind during pregnancy and the child's personality, the strongest associations (as judged by β size and the consistency of the effects), were those between children's personality constructs (affect & temperament) and CU traits. This was contrary to initial predictions that interactions between parenting and children's personality would be the strongest predictors of CU emergence.

In fact, neither of the two maternal constructs collected at pregnancy that were tested were significantly predictive of CU traits. While there was a borderline effect for depression ($\beta = -0.28$; $p = .058$), correlations between depression and CU traits suggest it is unlikely there is a linear relationship between these variables ($r = -.09$). Moreover, a strong correlation between depression and anxiety ($r = .57$, $p < .001$) indicates there may be an underlying construct, such as fear, which may better explain these findings. In contrast to the weak influence of maternal constructs during pregnancy, these findings suggest children's characteristics are the main predictors of CU emergence, which is consistent with reviews

suggesting CU traits are a stable, constitutional construct (Frick et al., 2014). That is not to say there are no caveats to this interpretation. Firstly, maternal variables assessed retrospectively did predict CU behaviours, but it was difficult to capture those specific constructs (fear and disinterest) earlier in development. In lieu of this, measures of related constructs were expected to replicate the same relationship, and perhaps these were not specific enough. Yet even retrospective associations were not as strong as those using the children's own characteristics; this was clear in study 3, and was replicated in this study. Second, characterising measures of the child's characteristics (child affect/child temperament/CU traits) as "constitutional" or "temperamental", masks variability in children's presentations which itself suggests that the profile associated with CU traits changes sometime during childhood. This second point is further discussed below, after the role of temperament is addressed.

As temperament was the only longitudinal construct predicting the later emergence of CU traits, and was itself associated with children's affective behaviours, a section of the analysis investigated which subscales of the temperament scale were driving these effects. Temperamental irritability was the subscale most strongly associated with both CU traits ($r = .54$, $p < .001$) and child affect ($r = .49$, $p < .001$). The irritability dimension is characterised by greater emotionality and negative reactivity, with items such as: "The baby is fretful on waking up and/or going to sleep (frowns, cries)" (Prior, Sanson, Smart, & Oberklaid, 2000; Sanson et al., 1987). It is therefore intriguing that this dimension is associated with CU traits, as by middle childhood children with high levels of CU traits are often characterised by a "colder" presentation, more closely related with unemotionality (Frick et al., 2014). Note that recent psychophysiological studies have found evidence for over- and not under-activation in children who later exhibit high-levels of CU traits. Over-activation has been indicated by reduced baselines of respiratory sinus arrhythmia (RSA) (Mills-Koonce et al., 2015; Wagner,

Mills-Koonce, Willoughby, Propper, et al., 2017), indicative of reduced emotion regulation; as well as a lower heart rate period (Willoughby, Waschbusch, Moore, & Propper, 2011), indicative of higher levels of general arousal; and a small but significant correlation with baseline cortisol, indicating higher cortisol levels at infancy were associated with higher levels of CU traits (Wagner, Mills-Koonce, Willoughby, & Cox, 2017).

On the other hand, behavioural evidence in infancy mimics the unresponsiveness characteristic of older children with high CU traits and psychopathic adults. For example, higher levels of CU traits were associated with lower increases in negative affectivity in response to the still-face procedure (Willoughby et al., 2011), and lower face-preference in infancy (Bedford et al., 2015). In this sense, a temperamental profile characterised by irritability during the first year of life may be indicative of the psychophysiological hyper-activation described above, without contradicting the behavioural lack of responsivity traditionally associated with CU traits. If this is indeed the case, it suggests future research should focus on two critical questions: (1) when are behavioural manifestations of CU profiles first made evident; and (2) when do psycho-physiological profiles switch from the hyper-activation seen in infancy to the hypo-activation characteristic of psychopathic responses to fear-conditioning paradigms and response-reversal tasks (Budhani, Richell, & Blair, 2006; Fairchild, Stobbe, Van Goozen, Calder, & Goodyer, 2010).

Conclusions

This study suggests that children's characteristics, such as their affective or temperamental profiles, predict higher levels of CU traits – both uniquely and in interaction with maternal anxiety during pregnancy. These findings are innovative in two respects: they suggest that the profile of children with CU traits in childhood is characterised not by coldness, but rather by irritability and dysregulated affective behaviours. Findings also

highlight the importance of pregnancy for the emergence of CU traits, particularly the influence of the mother's own mental health in this period. These issues were addressed using a small longitudinal sample with detailed information at critical time-points, and which answered retrospective measures when children were 4.

The strengths of the study include the high specificity of hypotheses, comprehensive assessments of participants, the inclusion of dyads with high levels of psychopathology, and the incorporation of a longitudinal design. The study was also subject to several limitations. First, a small sample size meant there was not enough statistical power to further explore interactions between variables. Second, most of the measures were self-reported by mothers, and thus subject to their cognitive biases. While the strange situation procedure, a behavioural measure, was included in the analysis, it showed none of the expected associations with affect or CU traits. However, the convergence of measures across broad periods of time suggests that maternal constructs were largely stable, and unlikely to be haphazard. Third, although care was taken to align the timing of longitudinal measures with retrospective measures, a three-month assessment of maternal disinterest while feeding might have been too late to adequately capture maternal feelings at the time. Fourth, the sample suffered high attrition due to families moving interstate, loss of interest in participating in the study, changes in their contact details, and a dislike of a blood test (at T3); while we took care to ensure that maternal anxiety (which was the main variable characterising the sample) continued to be evenly distributed, it is possible that attrition rates influenced the results.

These findings suggest it is critical to study early behavioural indicators of affective or temperamental dysregulation, as well as clarifying the psychophysiological profile of CU traits throughout childhood. Second, on the maternal side, there was a successful replication of a relationship between maternal disinterest during feeding and CU traits. In contrast, the relationship between fear at pregnancy and CU traits was in the opposite direction to that

expected, indicating that lower fear at pregnancy was associated with higher CU traits. While these relationships are intriguing, they were not replicated by longitudinal measures of related constructs, and might require more targeted behavioural investigations in order to adequately assess their role in the emergence of CU traits.

GENERAL DISCUSSION

Summary of main findings

The thesis included four studies investigating the role of parental- and child-affect in the early emergence of CU traits, testing hypotheses inspired by putative discrepancies, contradictions, and convergence of the attachment and CU literatures. More specifically, work around disorganised attachment suggests that the aetiological burden of affective dysfunction lies with the mother, and not with the child's temperamental difficulties; and yet children with CU traits, who are characterised by temperamental and personality difficulty, often present with a disorganised attachment. The first study investigated the intergenerational transmission of parental psychopathy to child CU traits, and its findings suggested strong transmission from paternal factor 1 psychopathy to child CU traits. In contrast, transmission from maternal factor 2 psychopathy to child CU traits was mediated by maternal warmth, in findings suggesting that more negative feelings (and lack of warmth) from mothers was associated with higher levels of CU traits. While not wanting to de-emphasise the potential role of fathers, results from this study narrowed the focus of the thesis into the emotional bond between mothers and their children.

To understand "warmth" between mothers and their children, the dyadic relationship was studied through an attachment lens. Previous studies had suggested that CU traits were associated with attachment disorganisation (Bohlin et al., 2012; Pasalich, Dadds, Hawes, et al., 2012; Willoughby et al., 2014b), hence this became the focal point of the inquiry. Attention was drawn to the fact that attachment disorganisation is considered primarily to result from the mother's dysfunction (i.e. inappropriate fearful/frightening behaviours, communication errors, deficient manifestations of affect), rather than the child's affective characteristics – which are central to CU aetiology. The second study therefore introduced

two measurement instruments aimed at detecting differences in children's affective behaviour (CAB) and maternal retrospective narratives about their early bonding moments with their children (ICBM). This study used a mixed sample of clinic and community participants to assess the validity and reliability of the measures. Both measures were found to be reliable, with all CAB items loading on a single factor and ICBM dimensions grouping well both across and within dimensions. The CAB/ICBM measures showed adequate temporal and multi-informant reliability. Lastly, both measures differed between clinic and community participants, reflecting real-world differences, as well as showing construct validity via their correlation with related constructs.

The third study used these measures in a cross-sectional prediction of CU traits. Retrospective reports of maternal fear during pregnancy and disinterest during feeding were associated with CU traits; as were children's affective behaviours. These findings suggested that factors associated with higher levels of CU traits include more fear during pregnancy, less engagement during feeding, and more affective dysfunction. These findings came from the testing of novel hypotheses applying the attachment disorganisation literature to a CU context. In contrast to the attachment literature however, the strongest effects were found for children's affective profiles, rather than any of the measures assessing maternal negative feelings towards the child. Broadly speaking, these findings suggest that some forms of attachment disorganisation may be largely driven by children. As the relationships proposed here are largely novel, they should be subjected to rigorous scrutiny, to prevent future researchers from focusing on random findings. In this sense, study three had two important limitations: first, the analysis was cross-sectional and used the same sample as that used to validate the questionnaires; and second, all measures were self-reported by parents. The concern regarding parental self-report may be justified in two respects: first, there is no standardised behavioural test of CU behaviour or parental negative feelings; and second,

parental self-reports may offer an insight into the parent's feelings which may not be shared by other reporters. For example, in Study 2 the association between warmth and CU traits was strongest when both of these variables were reported by the same parent – suggesting the variables captured the parent's own narrative, which may not have been the same for their partner. The first concern mentioned above, that of the cross-sectional nature of the analysis and the use of the same sample, could not have been addressed without carrying out another study.

The fourth study therefore set out to address these concerns: first, to replicate previous findings, and second, to test the same relationships longitudinally. The first part of the study replicated two out of the three relationships uncovered by study three: children's affective problems and maternal feelings of disinterest during feeding continued to predict CU traits cross-sectionally. Interestingly, maternal fear at pregnancy was also a significant predictor of CU traits, albeit in the opposite direction to that expected. That is, while the first study suggested mothers who were more fearful were associated with higher levels of CU traits in their children, this fourth study suggested mothers less likely to experience fear were more likely to have children with high levels of CU traits. Both of these relationships could be justified: on the one hand, it may be the case that children exposed to stress hormones in the womb become less sensitive to their effects. On the other hand, it may be the case that mothers who are fearless confer a risk for a fearless temperament in children. As the direction of the effect was inconsistent, our results cannot be said to suggest one or the other.

The second part of study four found that maternal disinterest during feeding was unrelated to longitudinal measures collected at 3-months post-partum. That is, while the retrospective relationship was found to be significant, disinterest was not correlated to any of the measures collected when the child was three months old. These findings were interpreted as suggesting that the 3-month time-point was too late in development to capture the specific

effects of the mother's mental state on the child's subsequent development. In contrast, children's affective behaviours at four were strongly associated with the infant's temperament at one. This association allowed us to explore whether infant temperament at one was indeed associated with CU traits, in a longitudinal test of the hypothesis that had been previously tested cross-sectionally. Infant temperament, particularly the irritability dimension, was found to predict CU traits such that more irritable children were more likely to be rated as having high levels of CU traits three years later. The finding regarding irritability is somewhat perplexing, as children with high levels of CU traits are less reactive than their non-CU peers by middle-childhood, in that they are less likely to show physiological and behavioural responses to emotional stimuli (Dadds et al., 2006; Hawes, Brennan, & Dadds, 2009). On the other hand, children with CU traits are considered to be *more* difficult to parent (Hawes et al., 2011) and show physiological profiles as infants that are associated with hyperactivation of the autonomic nervous system (Mills-Koonce et al., 2015; Wagner, Mills-Koonce, Willoughby, Propper, et al., 2017; Willoughby et al., 2011). Together these findings suggest that, at some point in development, the temperamental profile of children with high levels of CU traits switches from being one characterised by irritability and reactiveness, to the colder presentation associated with CU traits later in childhood.

The final section of study 4 explored interactions between child-level and maternal-level processes, finding that the risk of affective dysregulation (derived from both CAB and temperament scales) in the child was compounded by the mother's state of anxiety during pregnancy, with both effects indicating higher risk for the development of CU traits. More generally, these findings confirm those of study three: they suggest that the child's characteristics, particularly those related to their affect and their temperament, are important factors associated with the early emergence of CU traits.
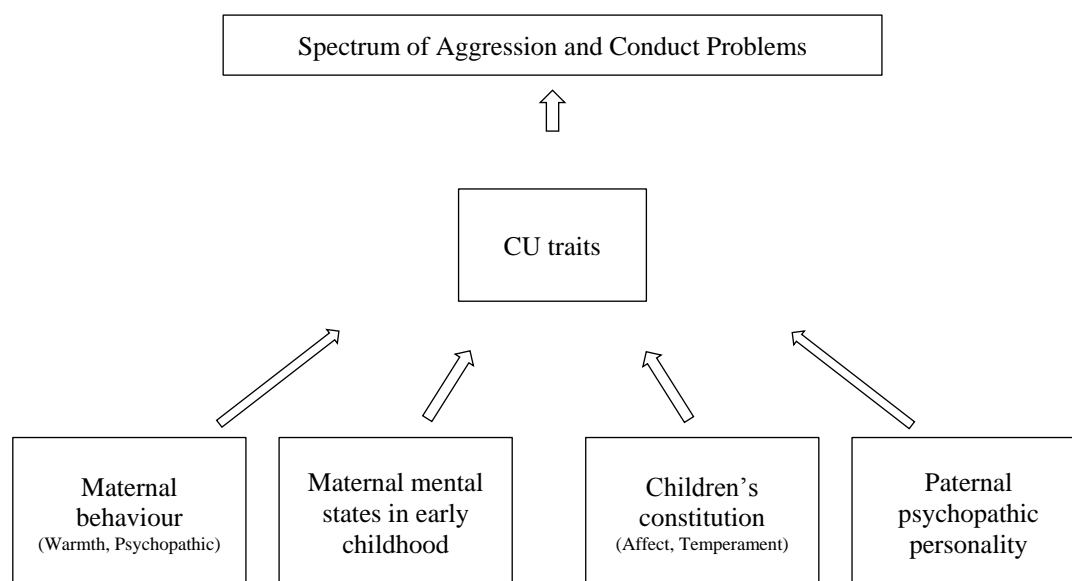
Fig. 5. Figure outlining trajectories towards CU traits. These factors could lead to aggression and conduct problems independently of the existence of CU traits.

Figure 5. above illustrates a diversity of factors leading to CU traits and/or to antisocial behaviours, four of which were the subject of study of this work. These are not the only factors associated with CU traits, nor are they thought to be exclusively associated with CU traits, as they may be independently associated with a spectrum of aggressive and antisocial behaviours. The importance of these findings does not lie in the fact that they designate a subtype of conduct problems – characterised by the presence of CU traits – but rather that they are a first step in understanding the processes linked with the development of CU traits themselves. The importance of these findings is therefore discussed not only in relation to aggressiveness and conduct problems, but also by focusing on CU aetiology.

Implications of main findings

This thesis set out to determine whether either of the predominant, but significantly diverging, theories regarding the placement of the aetiological burden of CU traits – that of attachment or that of the more general CU literature – were empirically supported. A

simplified version of the attachment narrative is that abusive, insensitive, frightening/frightened, or otherwise emotionally chaotic parenting may be responsible for an intergenerational transmission of interpersonal dysregulation (Madigan et al., 2006; Main & Hesse, 1990). This is in contrast with the CU literature, which has generally found little evidence for behavioural differences between parents of children with CU traits, and instead focuses on the child's own characteristics (Viding et al., 2009; Viding et al., 2008). While it is evident that both children and parents are important to understand the emergence of CU traits, this work sought to clarify which developmental framework was supported in the face of competing predictions. As findings in either direction would contribute to both a greater understanding of CU emergence, and to the subsequent development of treatment programs that might take advantage of these findings.

The case for a child-driven effect received considerable support throughout several studies, consistent with predictions from the CU literature. In Study 1 the most consistent predictor of CU traits were fathers' psychopathic traits, as this finding was replicated across informants. While the most parsimonious explanation is that this effect is driven by passive risks such as the inheritance of traits or the existence of a genetic predisposition, this interpretation is not robust, as these findings can also be explained through attachment models. However, when the ICBM and the CAB were used in Study 3 to probe whether parents' narratives and children's affective behaviour were associated with CU traits, the strongest association was between children's affective behaviours and CU traits. Findings from this study clearly favoured a narrative placing most of the aetiological burden within the child, as children's affective behaviours were more strongly associated with CU traits than any maternal mental state or bonding variable measured, including those that significantly predicted CU traits. Moreover, the longitudinal design of Study 4 produced results consistent with previous findings from Study 3, as children's affective behaviours again demonstrated a

stronger association with CU traits than either maternal state. Moreover, a longitudinal comparison of children's temperament and maternal anxiety/depression again indicated that children's characteristics, but not maternal states of mind, were significantly associated with CU traits. Together these results find that children's characteristics are repeatedly shown to have stronger associations with CU traits.

Yet an interpretation favouring an attachment framework could still present important challenges. Results from Study 1 also suggested that parental warmth was associated with CU traits, in a relationship that demonstrates that parents' feelings towards their children are valuable in understanding CU emergence. Even though the mechanism of transmission was unclear, as the evidence for behavioural transmission (through measures such as harsh parenting or the parents' own antisocial behaviour) was absent, findings from Study 1 could be interpreted as supporting an attachment framework if the mechanisms of transmission are the parent's responses to the child's emotional expressions, or subtle facial reactions to the child's emotions – behaviours that would not have been captured by the constructs assessed. This interpretation suggests subtle behaviours and patterns of interaction are the main mechanisms of transmission (Beebe et al., 2010), a view consistent with attachment studies that have found broad behavioural reports to be too blunt to capture the interpersonal subtleties occurring within dyadic interactions (Beebe et al., 2010; Lyons-Ruth & Spielman, 2004). Indeed, findings that warmth was most predictive of CU traits when assessed in combination with the parent's perception of CU problems suggests that parents' own narratives may be important to understand the association between warmth and the emergence of CU traits. Moreover, results from Studies 3 and 4 found that maternal disinterest during feeding and fright during pregnancy were consistently associated with CU emergence, in findings that support the influence of parents very early in development. Although the effects from parental variables were not as strong as those of the CAB, this

comparison does not do justice to some of the differences between these measures. For one, the CAB is a scale consisting of several items, whereas ICBM responses were used as single-items. For another, it may be the case that CAB scores themselves are preceded by the kind of dysfunctional parenting proposed by the attachment literature. Critically, while CAB and CU traits measured concurrent behaviours, the ICBM retrospectively assessed maternal states of mind, such that the stronger relation between children's affective behaviours and CU traits might have been due to their temporal synchrony, rather than due to the relationship itself. Taken together, these results suggest that the attachment framework should not be dismissed, as it provides valuable contributions to the aetiological understanding of CU traits.

While these challenges to the traditional CU interpretation are important, many of these have been addressed in the design of the studies. For example, Study 4 compared scales of maternal anxiety and depression to scales measuring children's affective characteristics; used a measure of children's dispositions that shows small to null associations with attachment (van Ijzendoorn et al., 1999); and used longitudinal measures for both children's characteristics and maternal states of mind. With regards to Study 1, while it is indeed possible that unclear mechanisms of transmission are parsimonious with attachment frameworks, they are also parsimonious with genetic or trait-based effects. Hence, it would be fallacious to assume that a lack of behavioural associations (through parenting or antisocial behaviour) implies the existence of the kind of subtle dyadic process favoured by attachment conceptualisations. Rather, results from Study 1 can be interpreted as supporting either the attachment or the CU framework. This same ambiguity cannot be extended to results from Study 3 and 4, which clearly favour a greater aetiological burden on the child. In their totality, results from this work suggest that children's affective behaviours, with the possible addition of other dispositional characteristics such as temperament, are the constructs most strongly associated with the emergence of CU traits. This view supports a

canonical profile of CU aetiology that suggests these children are more likely to present as difficult to parent, as they are perceived as less affectionate. Furthermore, it rejects the notion that maternal behaviours underlie the interpersonal problems associated with CU traits, as neither warmth, maternal fright or disinterest, or maternal anxiety and depression, were consistently associated with CU traits across studies.

Yet this view does not contest that the study of parenting and dyadic relationships is vital for progress in the field. Parenting plays a critical role in the development of CU traits, as has been repeatedly demonstrated across several studies (see Waller et al., 2015 and 2016 for a broad overview). In support of this, this work has identified innovative associations between specific periods of development, maternal cognitions, and the emergence of CU traits. The results from these studies suggest that parenting, when studied in relation to CU traits, must be understood as occurring in a context of marked dispositional difficulties that are likely to influence the parenting itself (Hawes et al., 2011; Waller et al., 2014). It is therefore important to examine the interactions between parental and child variables. Results from this work demonstrate that employing theoretically-driven models, especially those that allow the comparison of specific predictions from different developmental frameworks, presents a fruitful avenue of research likely to bear informative results. Having considered the implications of these findings for the attachment and CU literatures, it is also important to acknowledge that these findings have several broader impacts on the developing research on CU traits.

Implications for the broader CU literature

Findings from this thesis contribute to five broader areas of research within the CU literature: (1) the centrality of affect in CU aetiology, (2) the importance of the perinatal

period for the emotional development of children, (3) the interaction between maternal and child processes in the prediction of CU traits, (4) the importance of including fathers, and (5) the relationship between temperament and CU traits. Having explored the direct implications of these findings, it is now important to consider their broader effects on the future development of CU theory, to this end the following discussion will be more speculative than the material presented above, and will draw freely from both the results of the thesis and the broader literature.

1. The centrality of affect in CU aetiology.

It appears increasingly evident that affect plays an important role in childhood CU aetiology, as expressed by both the effects of parental warmth and the affective dysregulation associated with CU traits. Indeed, mounting evidence suggests that affective difficulties are not just tangential to CU aetiology, but a core part of the development of CU traits during childhood. To this end, future research should focus on clarifying whether warmth-related constructs can be differentiated from CU traits; in particular, whether problems with the expression and reception of warmth are part of the CU-symptom constellation (along with lack of guilt, lack of empathy, emotional flatness, and lack of concern about performance), rather than an external influence impacting its emergence. To understand this, it is important to clarify what is meant by "warmth" and "affect".

A number of studies investigating the impact of parental warmth have found it to be particularly important for children with high levels of CU traits and conduct disorder, as compared to children with conduct disorder but low levels of CU traits (Hawes & Dadds, 2005; Pardini et al., 2007; Pasalich et al., 2011a), with greater expressions of parental warmth protecting children from adverse outcomes (Waller et al., 2015; Waller et al., 2014). Yet this research faces two important challenges. One is a prevailing reluctance to commit to a clear

definition of warmth, with most authors understanding it as a vague gestalt construct arising from dyadic interactions. Conceptual flexibility allows different groups to include their own measures of warmth, but different operationalisations lead to the measurement of different constructs. For example, warmth in speech samples is judged by the use of positive descriptors (Waller et al., 2014), but the same is not so in video-recordings, where it is indexed by behavioural scales such as responsivity or involvement (Pasalich, Waschbusch, Dadds, & Hawes, 2014). This differs yet again for self-report measures, like that used in study one, which includes items such as "Sometimes I feel very impatient with him/her" (Mendoza Diaz, Overgaauw, Hawes, & Dadds, 2017). Pointing out this bedlam of operationalisation is not intended to detract from rather consistent findings across these different measures. Rather, in moving forward it will become paramount to disentangle what exactly is meant by warmth, particularly as children with CU traits have been found to have very specific deficits in emotion-recognition and attention, and it is unclear whether their perception and experience of warmth is the same as that of peers with low levels of CU traits.

Another significant challenge to this literature is its lack of success in incorporating the influence of children's CU traits on parental warmth, which suggests that children with high levels of CU traits impact their parents' expressions of warmth. These effects tend to be of similar magnitude as those in the opposite direction (Hawes et al., 2011; Waller et al., 2014), yet they are seldom integrated into conceptualisations of the family dysfunction accompanying CU traits. This is an important oversight for parenting models, which could include strategies for managing the children's effects on the parents, such as fostering resilience in parental warmth, or teaching parents coping strategies for dealing with stable negative behaviours. More broadly, warmth is generally understood as a property of parental affection. While parental affect does seem to be important for CU traits, results from studies three and four of this thesis suggest that children's expression of warmth and affect are highly

related to CU traits. In fact, the strength of the associations between the CAB and the different measures of CU traits suggests that problems expressing and experiencing affect may be central components of the CU aetiology in early childhood.

In support of this claim, it is important to differentiate what has been referred to previously as "affective dysregulation" from empathy and unemotionality. Unemotionality refers to a lower likelihood of displaying emotions. Although expressing emotions is an important part of what is treated as "affect", it is neither necessary nor sufficient to express affection. For example, physical contact or looking another's eyes may indicate warmth even in the absence of emotional expressions. On the other hand, empathy is defined as taking the position of the other, sharing their feelings and perspective (Viding & McCrory, 2017). While this is undoubtedly intertwined with affect, as both necessitate a third-party and the contagion of emotions, empathy does not include a behavioural reaction to the other's state of mind, whereas expressing affect does. That is, affect goes beyond the empathy script that says: "I feel what you feel", to include: "and I act in a way that shows you I care". Note that, although most of the behaviours included in the CAB scale can be traced to the attachment literature, unlike attachment, these are organised in a single dimension, and do not require categorical separation. Lastly, this view of affect as central to CU symptoms is consistent with clinical presentations of parents of children with high levels of CU traits and conduct problems, who report not only concerns with CU behaviours, but also worry about their children being fundamentally uncaring. In this sense, these findings are worthy of further exploration regarding the centrality of affective dysregulation for CU aetiology, as it was the construct most strongly associated with CU traits.

2. The importance of the perinatal period

While not as important as the child's traits, there was some evidence that parental feelings in the perinatal period also added value to the prediction of CU traits. As maternal states of mind preceding birth and shortly thereafter were associated with CU traits in two different samples. More specifically, retrospective reports of maternal fear at pregnancy and disinterest during feeding added significant value to the prediction of CU traits. Although the role of fear was somewhat unclear as the direction of its association with CU traits varied between studies, overall these results suggest that the perinatal period may hold significant clues regarding CU emergence. Similar studies have found the perinatal period to be critical for development, notably Cecil et al.'s (2014) investigation into the methylation of the OXT gene and Bedford et al.'s (2015) findings regarding face-preference differences at 5-weeks of age in infants who would be later categorised as having high levels of CU traits.

In this sense, the attachment literature may have been correct in identifying the year following conception as a sensitive period for the socio-emotional development of the child.[4] However, the results discussed in this thesis suggest that dyadic interactions are but one source of influence acting on the child's socio-emotional development. For example, although the literature on attachment highlights the role of fear, findings from studies three and four suggest that fear during pregnancy, rather than the fear displayed in dyadic interactions, was important for the development of CU traits. Thereby suggesting that intergenerational genetic and phenotypic characteristics may be passed on via a plethora of mechanisms, and behavioural measures may not capture the full extent of this transmission. In a similar sense, disinterest during feeding was not related to breastfeeding characteristics or to maternal mental health at 3 months of age. Yet disinterest might have been experienced

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[4] Ironically, the 1-year period is not as critical for the formation of attachment bonds, and has later been expanded to include approximately the first five years of life (Rutter, Kreppner, & Sonuga-Barke, 2009; Rutter & Sroufe, 2000).

as decreased sensitivity to the oxytocin rush accompanying breastfeeding, for example, or as reflecting disengagement from an unresponsive infant – that is, as a variable associated with sources of influence residing beyond the mother's own mental health. This conceptualisation challenges the focus on the dyad placed by the attachment literature, favouring instead the child's dispositional characteristics and other biological influences as important predictors of the emergence of CU traits. This is a view that is sceptical of the specificity of the constructs measured but trusting of their timing.

The argument could also be made that the temporal specificity was less important than construct specificity. This would hold that maternal disinterest and fear are important throughout early childhood, and not just during the time periods specified in the ICBM. Such a view would suggest that maternal states of mind are generally important for the development of CU traits – yet associations between maternal states of mind reported during pregnancy did not directly predict later CU traits. Likewise, in study three differences between CU and non-CU groups tended to cluster around specific time-points, rather than around particular dimensions. For these reasons, it seems more appropriate to characterise the perinatal period itself as important for the development of CU traits, this is particularly true for pregnancy and the period shortly thereafter. This view is consistent with research showing that trauma preceding birth is more likely to be associated with pure CU presentations, rather that trauma in middle-childhood, which is associated with a comorbid presentation of CU traits and anxiety (Cecil et al., 2014).

The perinatal period is gaining increased interest in other areas of child clinical psychology such as ADHD (Momany, Kamradt, & Nikolas, 2017) and externalising disorders (Mansur et al., 2017), with maternal depression during pregnancy being associated with later internalising and externalising psychopathology in children independent of the mother's post-partum depression (Lahti et al., 2017). These prospective associations and the findings from

the current thesis support the notion that the perinatal period is a sensitive period for the development of future psychopathology.

3. Interaction between child and parental variables in the prediction of CU traits.

Although CU traits can be linked with the perinatal period in general, as discussed above, it is important to develop a better understanding regarding how different types of risk interact. This was one of the major goals of the current work, and it is likely to remain a focus of developmental clinical psychology. The findings from Study 4 are the clearest demonstration of this effect, which found that children's dispositional characteristics interacted with maternal anxiety during pregnancy to predict CU traits. This aligns well with Study 3's findings suggesting that fear during pregnancy was important for the development of CU traits. At the same time, depression, which was also associated with fright during pregnancy and with anxiety, did not confer specific risk for CU traits, in a finding that suggests the specificity of the fear and anxiety variables may not extend to related constructs. Yet this same precision was not achieved with disinterest during feeding, and neither was it present in Cecil et al.'s (2014) study, in which it is not specified what parental risk variables (maternal psychopathology, parental criminal behaviour, or parental substance abuse) were most strongly associated with either CU traits or OXT methylation.

Identifying these specific associations would allow for the identification of *mechanisms* explaining how parental risk, which may be situated at a number of different levels (e.g. societal, behavioural, genetic), impacts the child's own affective and temperamental dispositions. The specificity of risk transmission was an important feature of Study 1, which identified several sources of parental risk and attempted to disentangle which of these were directly associated with the emergence of CU traits. Although this study did not take into account children's own developmental dispositions, it did find that intergenerational

transmission varied by gender. This is indicative of pathways that diverge by gender. Or more broadly, of an interaction between a parental trait-level variable and children's biology which helped to identify potentially important, but largely neglected relationships, such as the similarity between boys with high levels of CU traits and their fathers.

4. Fathers

As mentioned earlier, the most robust findings from study one showed that factor 1 psychopathy in fathers was associated with CU traits in children. This effect was strongest for boys. This thesis went on to focus on how warmth mediated the intergenerational transmission between psychopathy in mothers and CU in their children, yet the strength of the relationship between fathers and their sons was replicated across different raters. Similar findings have been reported in other studies, showing that fathers, but not mothers, presented with deficits in their gaze to the eyes of attachment figures (Dadds et al., 2011). Moreover, studies focusing on the intergenerational transmission of psychopathy have also alluded to strong associations between fathers' psychopathy and that of their children (Auty et al., 2015). As study one found no paternal variables to mediate this transmission, the relationship was treated as being largely driven through genetic risk conferred by fathers. However, as Auty and colleagues (2015) show, this effect may have been mediated by paternal psychosocial risk factors that were not included in study one. Auty and colleagues (2015) found evidence for both direct and indirect effects in the intergenerational transmission of factor 1 and factor 2 psychopathy – notably through paternal employment problems and to a lesser extent, substance abuse.

These indirect effects suggest it is likely there is a behavioural modelling or social learning component to the intergenerational transmission of psychopathy between fathers and their offspring, indeed a dual genetic and behavioural influence has already been identified

for mothers (Hyde et al., 2016). Yet relationships between fathers and their children have been largely ignored in favour of mother-child relationships, and there are no standard theoretical models akin to attachment dealing specifically with father-child dysfunction. While this led to the exclusion of fathers in the three subsequent studies of the thesis, it by no mean indicates that the influence of fathers should be dismissed. For example, it may be the case that the presence of a father scoring highly in factor 1 psychopathy may indirectly disturb the other relationships in the home, not necessarily by disturbing specific child-father interactions, but rather by fostering a tense or domineering environment, in which the child is constantly afraid to step out of line. In this case the "employment problems" discussed above may mask noxious relations between family members. Alternatively, it may well be the case that father-specific interactions do confer specific risk for psychopathy, as would be the case in the overt teaching of gender-roles, or in aggressive rough-and-tumble play with the child. In either case, understanding the cognitions and attributions of the father becomes important for the emergence of CU traits. Consistent with this conceptualisation, findings from study one suggested that when using paternal variables as both the independent and dependent variables; that is, when the analysis was conducted as if exploring the father's state of mind, paternal warmth became a significant predictor of CU traits. This has important implications for the study of CU traits, as it suggests fathers must be included in research, not just nominally through information on their demographic characteristics, but procedurally, in assessments and observations with participants.

5. Temperament and CU Traits.

Temperament was found to be highly predictive of CU traits in study four, in an effect driven by the irritability subscale, highlighting a characteristic that is not often associated with CU traits: emotional lability. CU traits have been described in some papers as 'cold' and unemotional (Dadds et al., 2012), and tend to be associated with proactive rather than

reactive aggression (Lozier, Cardinale, Van Meter, & Marsh, 2014). However, children with high levels of CU traits are not characterised by underactivity at home, and there is some suggestion they might be harder to parent (Hawes et al., 2011). In line with this, although associations between CU traits and proactive aggression tend to be robust, they are also associated with reactive aggression (Fanti, Frick, & Georgiou, 2008; Fite, Stoppelbein, & Greening, 2009; Muñoz, Frick, Kimonis, & Aucoin, 2008), which is itself associated with impulsivity. This is particularly true of children with co-morbid anxiety, which show higher levels of reactive and general aggression than children with high CU traits but low anxiety (Kimonis, Skeem, Cauffman, & Dmitrieva, 2011). This raises two possibilities with regards to findings from study four: one is that the higher prevalence of anxiety in mothers (as half of them had high separation anxiety) meant that children with high CU traits also had a generally high baseline of anxiety. Therefore, the correlation between irritability and CU traits could be representative of a correlation between irritability and the secondary variant of CU traits. However, this is unlikely as anxiety was uncorrelated with CU traits in the sample (analysis not included). This suggests the second possibility might be more applicable.

The second interpretation of this association is that children with elevated levels of CU traits present as more difficult children to parent, particularly early in life. As described earlier, this interpretation is consistent with psychophysiological findings associating an overactive autonomous nervous system with higher levels of CU traits (Mills-Koonce et al., 2015; Wagner, Mills-Koonce, Willoughby, Propper, et al., 2017; Willoughby et al., 2011). Yet findings supporting physiological hypoactivation in adulthood and later childhood (Blair, 2013; Fanti, Panayiotou, Lombardo, & Kyranides, 2015), suggest that this temperamental profile must switch sometime in childhood. This is an intriguing possibility that designates early childhood as a particularly important period to understand the emergence of CU traits. Yet this interpretation is not without challenges. For one, attentional deficits to emotional

faces are present in 5-week old infants who will later develop high CU traits (Bedford et al., 2015). Suggesting that the change from emotional lability to 'coldness' may occur either independently from other cognitive or attentional deficits associated with CU traits, or as a downstream consequence of these pre-existing conditions (Moul, Killcross, & Dadds, 2012). What's more, the association between temperament and CU traits in this thesis might be due to associations with third variables, for example: a difficult temperament has been associated with CU traits through its effects on parental warmth, suggesting more difficult children are less likely to elicit warmth and therefore do not receive the benefits associated with a warm relationship with their parents (Waller et al., 2016). In all, the associations between early temperament and CU traits are largely unknown, but results from this study highlight temperament as an important area of research for future studies.

Strengths and Limitations

The strengths and limitations of the overall project, discussed below, aim to clarify the methodological choices that underlie the work. To achieve this, four areas are briefly discussed: the thesis statement, the sample, the use of retrospective measures, and the replication of findings.

A precise hypothesis

The most significant strength of this work lies in its hypothesis, or thesis statement; namely, that the presence of attachment disorganisation in children with elevated levels of CU traits represents a theoretical challenge for two central areas of developmental psychopathology. By highlighting divergent views on the roles of fear, temporal processes, and children's contributions, three areas of tension were identified that guided the structure of the different studies and measures developed. In this sense, the work is conceptually driven,

and posits a specific, novel, testable hypothesis that challenges dominant paradigms in the field.

Sample

The samples used throughout the different studies are both a strength and a limitation of this work, and in order to understand the decisions driving sample-selection each study must be discussed separately. Study 1 necessitated a clinical sample to guarantee sufficiently high rates of both parental psychopathy and elevated levels of CU traits in children. Moreover, as previous studies had tended to employ different combinations between the genders of both parents and their children (e.g. son-mother, father-daughter, father-son), the sample of Study 1 incorporated children and parents of both genders. While the use of a large clinical sample represents a substantial strength, the division of the sample by gender meant that the inferential power of the sub-sample of daughters was lower than that of sons. This limited the strength of conclusions regarding gender-differences, which was an important aim of the study. This limitation was addressed by first analysing the entire sample, and only focusing on gender-differences in subsequent analyses. The conclusions of the study were also carefully constructed to discuss what was common between samples first, and to mention gender-differences as a finding in need of subsequent replications. Another limitation of this sample is a difficulty in establishing biological descendance from both parents, as the variable indexing non-biological relationships between children and parents was only selected when neither parent was related to the child. These cases were not considered in the analyses, as there were very few instances of children who were biologically unrelated from either parent. Nonetheless, it is possible that children had a biological connection to a single parent, this is an important consideration which would alter the proposed mechanism of transmission from biology to learned behaviour. While analysing this question is beyond the

scope of the present study, adoptive studies, such as those mentioned earlier by Waller and colleagues (2016) are beginning to disentangle these associations.

The main sample from Studies 2 and 3 consisted of a large mixed-group of clinical and community parents. The choice of using a mixed-group, rather than analysing each group separately, is contestable. The main point of dispute is that aetiological development may follow different courses in each group of children; that is, that processes responsible for the emergence of CU traits in children from a clinical group presenting for behaviour problems at a child-treatment clinic may not be shared by children with high CU traits in the community. The present work challenges that view, and argues that it represents a flawed understanding of the literature. This view is based on two points, the first is that the CU construct represents a dimensional category which ought to be normally distributed in the population (Frick et al., 2014), therefore a mixed-group with wide variability in CU levels would have a stronger power to detect the kind of aetiological processes that were hypothesised. The second is that advocating for separate analyses would conflate CU traits with aggression, as it is necessary to study children with and without elevated levels of aggression to guarantee that aetiological processes identified are specific to CU traits, and not only a feature of aggressive subgroups. To clarify, this position argues that analysing groups of aggressive children with CU traits occupies a key place in the CU literature, but that in order to identify aetiological processes specific to CU traits it is important to combine the community with the clinic. Lastly, while a countervailing point could be made that these groups should be studied separately but only processes common to both would be considered as being true to CU aetiology, this response ignores the equifinality common to developmental psychopathology, as equal end states in each group might have been reached by different means.

The sample of Study 4, which was also used briefly in Study 2, consisted of a group of about 45 mother-child dyads participating in a longitudinal study focused on separation

anxiety in mothers and its cascading effects. Strengths of the sample included high emotional lability in mothers (half of the sample had elevated levels of separation anxiety at recruitment), recruitment from an area with high variability in socio-economic status – which might indicate higher overall risk for future psychopathology, and the use of a longitudinal design. The incorporation of a longitudinal design is a critical strength, as the central hypothesis of the thesis is concerned with developmental maturation.

However, there were some constraints regarding the sample, as it had generally low levels of externalising problems and low levels of CU traits as compared to samples referred to clinics for behaviour problems. While the variance between different children was substantial, it tended to be clustered towards the lower end of the scale, and behaviourally the children were more likely to present as anxious. These characteristics presented several limitations, as many of the previous studies examining affective processes involved in CU emergence had done so with more severe cases that were accompanied by aggressive or oppositional behaviours (Frick et al., 2003; Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012b; Loney et al., 2003; Pasalich, Dadds, Hawes, et al., 2012; Pasalich, Dadds, Vincent, et al., 2012). Although baseline differences were not concerning in the context of replication (indeed it could be argued that replication given these baseline differences demonstrates robustness), differences between this sample and those of other studies are important when reporting novel findings. This is a limitation of Study 4's findings linking temperamental irritability in children to the later emergence of CU traits, as they require replication in larger samples with broader variability in CU scores. However, as noted, new psychophysiological evidence supports the interpretation of Study 4's findings (Wagner, Mills-Koonce, Willoughby, Propper, et al., 2017; Wagner, Mills-Koonce, Willoughby, & Cox, 2017).

Retrospective measures

The use of retrospective measures such as the ICBM can also be considered as a strength or limitation of the current work, as retrospective measures can be divisive. Criticisms of retrospective measures tend to be centred on concerns around the malleability of memory and the inaccurate recollection of past events (Loftus, 1993; McNally, 2003). Indeed, it has been shown that people are highly susceptible to memory distortion and can be made to believe that events that never occurred had in fact transpired (Loftus, 2003). However, the ICBM is not interested in the accurate recall of specific aspects of memories, such as dates or whether an event occurred or not, but rather on the position of a group of parents relative to the broader population of parents. This point is best illustrated with an example: the ICBM does not set out to measure the amount of times parents' produce specific behaviours or which period corresponds to a particular behaviour, but rather whether parents report feeling more or less anxious/frightened/depressed than other parents answering the same tool. The use of retrospective measures for this type of assessment is unproblematic (Henry, Moffitt, Caspi, Langley, & Silva, 1994). Moreover, research suggests that in order to enhance the reliability of memories these should be anchored to specific events (Brewin et al., 1993), which was achieved in both the explicit structure and the formatting of the ICBM.

Retrospective measures are not simply mediocre versions of concurrent measures, as retrospective measures outperform concurrent predictors under several circumstances. For example, while concurrent predictors are better measures of objective experience, retrospective measures have been found to be superior predictors of choice (Wirtz, Kruger, Scollon, & Diener, 2003) and of psychopathological risk (Newbury et al., 2018). Retrospective measures are commonly used when collecting information about childhood traumatic events (Bernstein et al., 1994), dietary history (Byers, Marshall, Anthony, Fiedler, & Zielezny, 1987), and medical history. In this work, the use of retrospective measures in Studies 2 – 4 allowed authors to assess a wide window of time within the relatively

constrained period of a PhD[5]. The section on future directions, discussed below, will delve into the importance of incorporating behavioural measures.

Inferences

The inferences drawn from the studies presented above, although statistically and methodologically robust, are subject to limitations due to the study's design. Chief among this is the cross-sectional nature of most of the analysis, which did not permit cross-lagged analysis that might better approximate the interactions between different variables as both cause and effect. Secondly, it is important to consider that many of the findings in the thesis might have been significant only within the context of the specific study being carried out, and might be difficult to replicate across studies or in different settings. Indeed, the reliability of psychological findings has recently been called into question in several large replication studies (Open Science Collaboration, 2012, 2015). This is the subject of the replication section below; however, it is also important to acknowledge there are limits regarding how much "trust" can be placed on the results of any single study. In this particular work, the relationship between the CAB and CU traits was consistent and robust, it was present every time it was tested, and had a similar magnitude at different age groups, across genders, and across samples. The association between paternal factor 1 psychopathy and CU traits was also strong, resisting the addition and exclusion of covariates. However, the relationship between maternal states of mind and CU traits was weaker, as is acknowledged in the section above regarding retrospective measures, and must be further studied before it can be considered a feature of CU aetiology. Third, the design of the studies in the thesis – at times by nature of being carried out for the completion of a PhD project – could not be done as longitudinal studies. A longitudinal design examining cross-lagged relationships would have

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[5] Doctoral studies take 3 – 4 years in Australia whereas in other countries such as the United States they take an average of 5 – 7 years. This work was produced in 3.5 years.

been able to make stronger inferences regarding the influence of parent vs. child effects. Yet unfortunately this design could not be accommodated within the time-constraints of a PhD. In the future, it will be important to integrate these kinds of designs with genetic information that may be able to parse out commonalities between parents and children, which would hopefully help to elucidate the unique contributions of each of these elements. These design changes would allow inferences from the analysis to be more robust, as they would be better able to consider multiple sources of variance within more sophisticated analytic methods.

Replication

Finally, an important strength of this work is that findings from Study 3 were largely replicated in a smaller but longitudinal sample in Study 4. The ability to successfully demonstrate that hypothesised effects are at play across different contexts has become increasingly important, as the field responds to concerns about the replicability of psychological findings (Collaboration, 2015). No single study is free from random or systematic errors, and in an attempt to differentiate the analyses between these groups different software packages were used, with R as the main tool of Study 3, and the analysis of Study 4 conducted in SPSS. Moreover, the dependent variable was purposefully changed between studies, from the UNSW scales in Study 3 to the ICU in Study 4. Yet the relationships between both children's affective behaviours and maternal disinterest while feeding remained significantly associated with CU traits. Intriguingly, the relationship between fright at pregnancy and CU traits was significant in both studies, though in different directions – that is, whereas more fright during pregnancy was associated with higher levels of CU traits in a large mixed sample, less fright during pregnancy was associated with higher levels of CU traits in the sample characterised by separation anxiety. Ultimately, replication efforts should be conducted by different laboratories, as it guarantees broader generalisability, an issue discussed in the next section, future directions.

Future directions

This thesis presented novel associations between children's affective behaviours, parental mental states, and the emergence of CU traits. Although each study's discussion included comments on the future directions of specific lines of inquiry, this section allows for a broader discussion regarding which issues should be addressed by future studies examining areas of tension between attachment disorganisation and CU traits. The main concern of future studies examining these associations ought to be the inclusion of behavioural measures. This is particularly important for studying dyadic interactions in the perinatal period, as the collection of observational data tends to be delayed until babies are old enough to visit the lab. Although notable exceptions can be found in the work of Wagner, Bedford, Willoughby and colleagues (Bedford et al., 2017; Wagner et al., 2016), who have assessed associations between infancy and the later emergence of CU traits.

As a related concern, the evidence supporting an association between attachment disorganisation and CU traits is strongest when measuring attachment during middle childhood with narrative tasks like the MCAST (Bohlin et al., 2012; Pasalich, Dadds, Hawes, et al., 2012). In contrast, Willoughby et al. (2014) found a smaller association between disorganisation and CU traits when using the SSP; and in Study 4, there was no association between disorganisation as assessed by the SSP and CU traits. Given these observations, it will be important for future research to clarify whether children with high levels of CU traits are being categorised as disorganised as a result of a specific set of behaviours (e.g. freezing, acting aggressively, or having an incoherent narrative) that are associated with disorganisation in narrative tasks, but not (or less so) in the SSP.

A third area that is critical for progress in developmental psychopathology is the inclusion of fathers in research examining longitudinal associations predicting CU traits.

Although there was an attempt to engage fathers during the data collection process of Studies 2 and 3, ultimately the pool of fathers was not large enough to be included in the main analyses. In the future, a concerted effort should be made to use strategies designed specifically for the recruitment and retention of fathers, as there is now growing evidence showing that their dispositional profile is likely to be similar as that of their children (Auty et al., 2015; Dadds et al., 2014; Mendoza Diaz et al., 2017).

Lastly, associations between children's affective behaviours and callous-unemotional traits were strong, and should be integrated into the literature. This could be achieved in several ways. One is by investigating the centrality of affective disturbances early in childhood for the later development of CU traits. A second is by examining the effect of children's dispositional characteristics on parenting, specifying which infant behaviours are perceived as challenging the warmth of the parent-child relationship, and providing strategies to manage either the behaviours themselves or parental responses to these behaviours.

Conclusion

This thesis argued that there were areas of tension between aetiological models of CU traits and attachment, exemplified by conflicting views on the importance and timing of parental mental states and behaviours. Ultimately, these models made different predictions, with attachment models placing the majority of the aetiological burden on parents, and CU models placing it on children. The intersection of these models allowed the examination of affective dysregulation in a group characterised by trait-driven interpersonal problems.

Study 1 examined the intergenerational transmission of CU traits to test whether parenting, either through warmth or through harsh behaviours, was associated with the emergence of CU traits. It found that parental warmth was indeed important, as was the direct transmission of traits between generations. Study 2 developed new tools that allowed the

dissection of early dyadic interactions and the summation of child affective behaviours into two measures, the ICBM and the CAB. These measures were found to be associated with CU traits in Study 3. Specifically, mothers reporting less interest while feeding, and more fear during pregnancy were more likely to report having children with high levels of CU traits. The CAB showed an even stronger association, indicating children's affective behaviours are highly related to behaviours indexing CU traits.

Study 4 replicated previous results in a cross-sectional analysis, but longitudinal analyses indicated that only children's dispositional features – their affect and temperament – directly predicted CU emergence. Whereas maternal anxiety during pregnancy was predictive of CU traits only in interaction with children's affective features.

Results suggested that although some of the general predictions of attachment models were supported, ultimately, the aetiological burden was largely driven by children's own dispositions. This suggests that while parental influences on CU traits are likely to be important (particularly during early childhood), children characterised as having high levels of CU traits demonstrate specific features from early in development that cause them to be judged by parents as being more difficult to parent than other children. This manifests as higher ratings of affective dysfunction and temperamental difficulty.

These results offer several suggestions for future studies, including a greater focus on dispositional characteristics of children and their relationship to CU traits, as well as the integration of fathers into developmental models and the use of specific behavioural assessments. Ultimately, this analysis demonstrates the importance of employing theoretically-driven models, especially those that allow the comparison of specific predictions derived from different developmental frameworks.

APPENDIX A

Missing data analysis took three forms, first three dummy variables were created indicating whether there was data missing for mother, father, or teacher. This approach tested whether splitting the sample by any of these groups resulted in significant differences between the variables used in the study. For example, a dummy variable could be used to test whether mother ratings of CU traits differed depending on whether father data was present or not. This analysis was carried out using a pair of one-way ANOVAs. There were no significant differences in CU, harsh parenting, warmth, paternal psychopathy, or paternal mental health. However, there were differences in maternal reports of psychopathy, such that maternal primary psychopathy was higher for cases in which either father or teacher data was missing. Likewise, maternal secondary psychopathy and maternal psychopathology was higher for cases in which no father data was available.

Second, the relationship between parent's marital status and CU traits was tested by creating a dummy variable which split CU traits into either high (score of 8 or higher in any rater's report of CU traits), or low. The cut-off of eight was chosen as it represented a score above the 75th percentile for the sample. The low CU group consisted of 201 individuals, while the high CU group consisted of 102 individuals. This allowed the use of marital status in a chi-square analyses to compare whether differences in household structure were associated with a high severity of CU traits. Marital status was coded into six categories: married, de facto, separated, divorced, single, and other. No significant differences between groups were observed: $X^2 (5) = 9.75$, $p = .083$.

Table A.1. Differences between groups given missing data

	Missing Teacher Data			Missing Father Data		
	Data Present: Mean (SD)	Data Missing: Mean (SD)	F (*p*)	Data Present: Mean (SD)	Data Missing: Mean (SD)	F (*p*)
CU traits – Mother	5.30 (2.17)	4.83 (2.26)	2.44 (.120)	5.29 (2.20)	4.88 (2.19)	2.00 (.159)
CU traits – Father	5.31 (2.26)	5.23 (2.18)	0.04 (.840)	-	-	-
CU traits – Teacher	-	-	-	5.44 (2.27)	5.81 (2.52)	0.96 (.328)
Mother Primary Psychopathy	**22.63 (5.76)**	**24.51 (6.76)**	**5.21 (.023)**	**22.61 (5.88)**	**24.38 (6.36)**	**4.98 (.026)**
Father Primary Psychopathy	25. 83 (6.63)	25.46 (6.94)	0.10 (.752)	-	-	-
Mother Secondary Psychopathy	18.99 (4.37)	18.96 (4.28)	0.01 (.959)	**18.66 (4.47)**	**19.91 (3.84)**	**4.80 (.029)**
Father Secondary Psychopathy	25.83 (6.63)	25.46 (6.94)	0.33 (.568)	-	-	-
Mother Warmth	22.56 (4.49)	21.36 (5.20)	3.46 (.064)	22.59 (4.56)	21.39 (4.93)	3.74 (.054)
Father Warmth	20.19 (5.29)	20.24 (5.67)	0.01 (.963)	-	-	-
Mother Psychopathology	33.61 (28.76)	30.43 (30.10)	0.64 (.425)	**30.93 (27.87)**	**38.56 (31.72)**	**4.00 (.046)**
Father Psychopathology	28.16 (25.31)	25.81 (22.68)	0.29 (.591)	-	-	-
Mother Harsh Parenting	-0.001 (0.58)	0.004 (0.59)	0.01 (.950)	-0.007 (0.54)	0.024 (0.67)	0.17 (.680)
Father Harsh Parenting	-0.014 (0.57)	0.062 (0.63)	0.56 (.454)	-	-	-

In contrast, a chi-square analysis using fathers' missing data and marital status was significant $X^2 (5) = 77.63$, $p < .001$, indicating that for most of the cases in which data is present (88.2%) the couple is married. In contrast, missing data is divided into three categories: separated (35.1%), married (29.9%) and divorced (20.8%). It is unclear why a third of fathers' missing data comes from married couples, as the clinic's standard procedure is to contact both family members. However, it seems unlikely that fathers' missing data constitutes a homogenous category which is being ignored in the analyses, rather these results

support the notion that there is a diverse range of factors limiting father participation in parenting programs (Tully et al., 2017).

Third, the analysis was re-run including only those families in which the father was present. However, note that due to the nature of the analyses whenever both father and mother variables were included the models were already constrained by SPSS into those families with both father and mother data. For example, in Table 1.3 of the study there are four models, following a 2x2 design: $DV_{mothers}$ x $IV_{mothers}$, $DV_{mothers}$ x $IV_{fathers}$, $DV_{fathers}$ x $IV_{mothers}$, $DV_{fathers}$ x $IV_{fathers}$. Out of these, only the first model changed, as the sample size was reduced from 296 to 220. Results from this model are presented below in Table A.2. This model shows similar relationships to those present in the study above, with standardised beta weights of similar magnitude and direction for factor 2 psychopathy, although these results are not statistically significant.

Moreover, note that maternal psychopathy was higher in cases with missing father data, as shown in Table A.1, and that a greater variance in psychopathy scores may have been necessary to discern the effects of factor 1 vs. factor 2. As in our main results, the introduction of warmth to the model in the second block attenuated the relationship between factor 2 scores and CU traits. Finally, the restricted sample was split by gender (boys n = 157, girls n = 62), which revealed that the mother's factor 2 (but not factor 1) psychopathy was a significant predictor of boys' CU traits in the first block of the regression, but not the second. This relationship was not replicated for girls.

Table A.2. Mother variables predicting mother-rated CU traits, only including mothers from households with father data.

Mother-Rated CU Traits

	Variables	B (Std. Error)	t	*p*
1	Constant	-	5.19	<.001
	Factor 1	.10 (.03)	1.32	.190
	Factor 2	*.10 (.04)*	*1.24*	*.218*
2	Constant	-	.82	.412
	Factor 1	.15 (.03)	1.89	.061
	Factor 2	.01 (.04)	.14	.893
	Harsh Parenting	.01 (.03)	.20	.841
	Warmth	**.26 (.03)**	**3.57**	**<.001**
	Psychopathology	-.02 (.01)	-.29	.771
	Age	.03 (.05)	.47	.641

As missing data analyses found no differences in children's CU traits depending on whether father or teacher data was included, we think it is appropriate to move on with the analyses. Although significant differences in maternal scores were found, both of these groups are included in the analysis, and further investigation into this difference is beyond the scope of the current analysis.

APPENDIX B

BART model

As described in Study 3, the BART model generates a large number of decision trees, identifying which variables are most likely to predict a specified outcome. BART models do not output a single "optimal" tree, but rather they identify which variables are most likely to be included in a large number of decision trees. As BART models may be "fit" to the data, part of its output is model-fit statistics that were largely ignored in Study 3, as the intention of the study was not to create an optimal fit to the data, but rather to whittle down the number of variables to those most strongly associated with CU traits. This appendix allows the inclusion of more details regarding the BART model.

Model assumptions

The model had a total sample size of 298 cases, and 42 variables were compared in 250 burn-in and 1000 post burn-in iterations. In-sample statistics (L1 = 615.05; L2 = 1993.10) showed a pseudo-R^2 of 40%, and a root mean square error of 2.59. These results indicate the model was not a good fit to the data (as many of the variables included were not significant predictors of CU traits).

The Shapiro-Wilk test of normality of residuals was significant ($p = .002$), indicating the data was not normally distributed. Likewise, a zero-mean noise test ($p = .964$) indicated the noise was not normally distributed. Figure B.1 shows a Q-Q plot of the data and maps residuals against their fitted values, where it can be appreciated that while distributions are not wholly normal, they do not show marked biases beyond what would be expected in a dataset representing real-world characteristics.
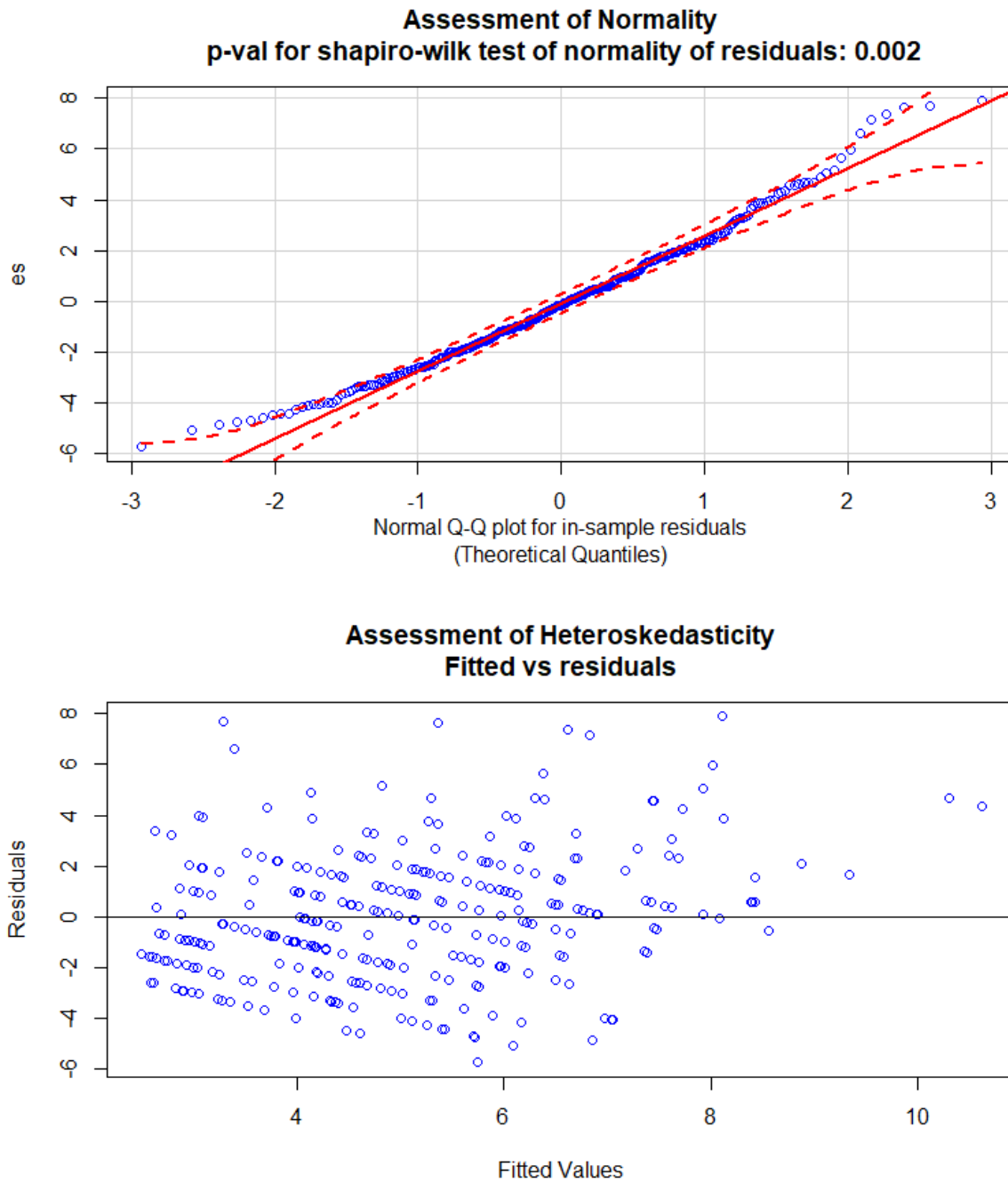
Figure B.1 Assessments of the models' assumptions regarding the distribution of error in the data.

Covariate importance

The model output also allows to test the importance of a specific covariate to the model. It achieves this by examining how the model's predictive power is influenced by the removal of the relationship between a predictor and the dependent variable. The Bart Machine code can then produce histograms representing the distribution of models with "null" pseudo-R^2 values. Two examples of these models are included in Figure B.2 below, one for the CAB and one for disinterest during feeding, which help clarify what these represent.
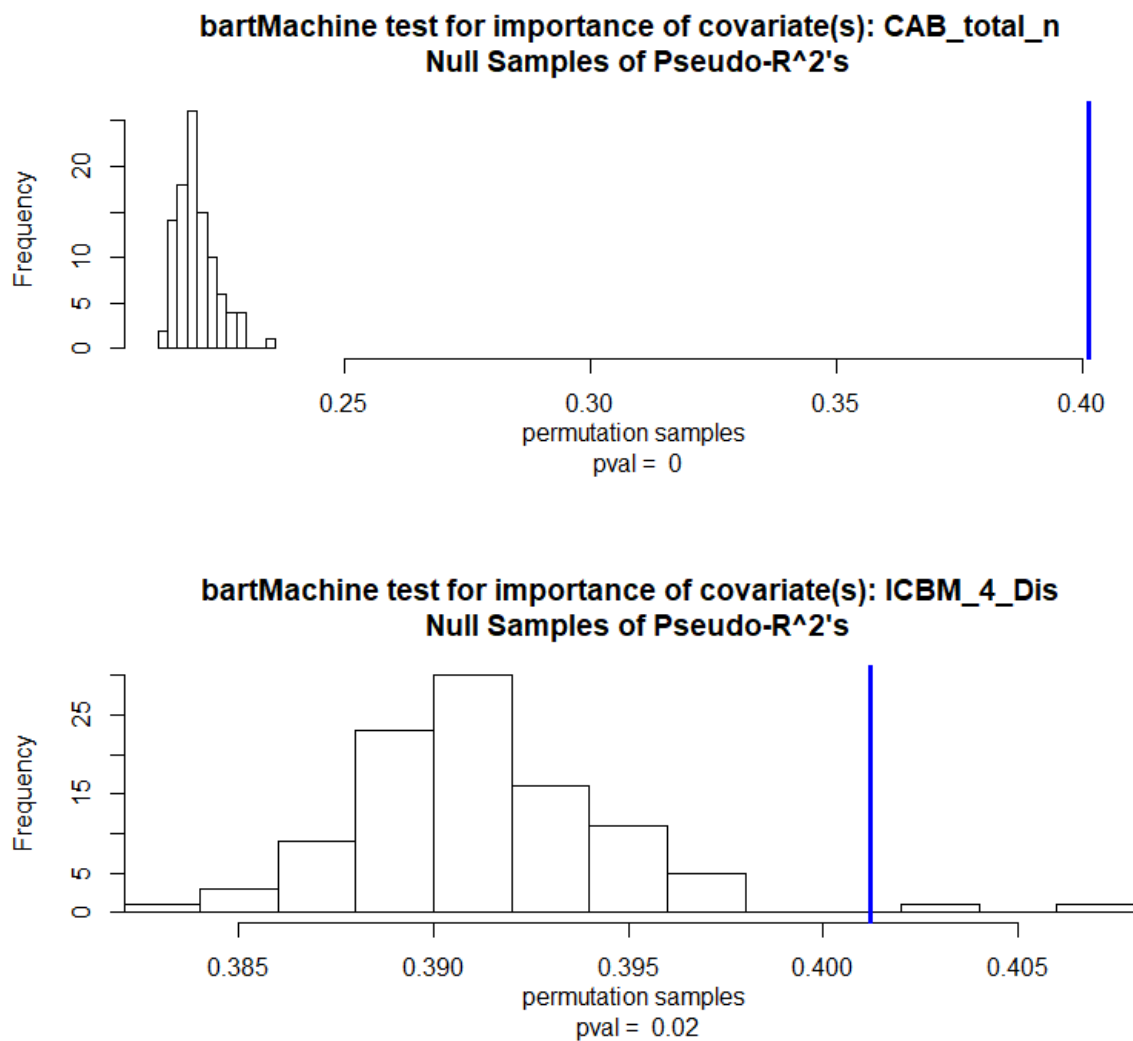
Figure B.2 Graphical representations of covariate importance

The model at the top of Figure B.2 investigates the CAB variable, and it shows that in all models in which the relationship between the CAB and the CU variable was removed (as the CAB variable was permuted) the pseudo-R^2 values were significantly lower than the 40% reported above. In fact, all models had pseudo-R^2 lower than 25%, suggesting that the CAB was the main predictor of CU traits. In confirmation of this, a test of the change in the pseudo-R^2 of the model is highly significant ($p = .001$), indicating pseudo-R^2 values were significantly lower when the relationship between the CAB and CU traits was removed.

In comparison, the bottom of the figure shows the distribution of pseudo-R^2 values for models in which the relationship between disinterest during feeding and CU traits was removed. Here, the pseudo-R^2 of models does not change as dramatically as it does when the CAB was removed, with most models continuing to predict between 39 to 41% of the variance in CU traits. However, most models simulated were worse when this variable (disinterest during feeding) was removed, with the exception of the two to the right of the blue line. A test comparing the change in pseudo-R^2 values suggests these are significantly lower when disinterest during feeding is removed from the model ($p = .02$).

APPENDIX C

Appendix C presents further evidence regarding why expected relationships from hypotheses B were not corroborated in the data. That is, relationships between ICBM/CAB variables and the longitudinal variables examined (Attachment, Worry) have strong theoretical support, but were absent from this study. The analysis presented below attempts to query these relationships to better understand these measures in the context of this study.

Worry

Part of hypothesis 1a proposed a strong association between fear at pregnancy and the mothers' worries during pregnancy. The "worry" item presented an interesting opportunity to find out what might have been the source of mothers' worry during pregnancy. However, there was no association with the dichotomous variable ($r = .06$, $p = .686$). A chi-square analysis was also performed in order to explore whether a particular type of worry was associated with CU traits. Categories included the following "worries": financial, loss or death, housing changes, other, and N/A. To do this the CU variable was split such that participants in the top 25% of the sample were considered as "high CU" and 75% as "low CU". These proportions tend to occur naturally among other clinical populations studied (Kimonis, Cross, et al., 2013). The chi-square analysis was not significant $X^2 (4, 38) = 1.92$, $p = .751$. Indicating there were no differences in CU distributions between the categories. Traditional attachment disorganisation models suggest "Loss or death" might be particularly relevant for the development of CU traits, yet only 2 mothers of the low CU sample had selected loss or death as a significant concern, and only 1 of the high CU children had done the same. None of these three children were classified as disorganised in the strange situation procedure.

Attachment

Part of hypothesis B proposed a strong association between children's affective profile and their performance in the Strange Situation Procedure. As before, there was no association between either the disorganisation variable or the attachment security (categorical) variable and either CAB scores (Disorganisation: r = -.01, *p* = .977; Security: r = -.22, *p* = .161) or CU traits (Disorganisation: r = .04, *p* = .809; Security: r = .03, *p* = .871). The relationship between attachment security and CU traits was also explored using a chi-square test, better suited to categorical variables, and it yielded the same result: X^2 (1, 44) = 0.11, *p* = .736. There were no significant differences in the distribution of CU cases across secure/insecure categories. This may have been due to an earlier measure of attachment than those used in prior studies, which measured attachment at older age groups (Pasalich et al., 2012; Bohlin et al., 2012; Willoughby et al., 2014b). It is possible that by middle childhood attachment crystallises into more stable categories, this would be consistent with twin-studies showing that genetic contributions to attachment increase with age (Fearon et al., 2014). It is also possible that this lack of an association has to do with the characteristics of the sample, as the overall levels of CU traits were low, and the variance in the measure was concentrated among the lower end of the scale.

Other relationships we expected with these attachment variables were not present in the study. For example, temperament when the child was 1 was not associated with their attachment style at the same age (Disorganisation: r = -.17, *p* = .279; Security: r = .18, *p* = .254), and in fact some of these relationships show a trend in the *opposite* direction to what was expected. That is, more temperamental difficulty was associated with less disorganisation. However, the relationship between attachment and temperament is notoriously difficult to replicate (van Ijzendoorn et al., 1999).

Yet attachment was not associated with maternal bonding either, for either disorganisation (r = .17, p = .259) or attachment security (r = .20, p = .183). Moreover, there was no association between disorganisation and mother-reported externalising symptoms (r = -.001, p = .996) – as measured using the Child Behaviour Checklist for toddlers, completed when the child was 4 (T4). The relationship between attachment disorganisation and externalising behaviour has been well-validated, notably in a meta-analysis by Fearon et al. (2010).

In conclusion, the analyses suggest that (in this study) there is no support for the relationships hypothesised between worry and attachment and the ICBM/CAB variables. This is due a low incidence of significant worries among participants, and a failure to replicate previously studied associations with attachment. It could be the case that mothers who have been high in separation anxiety, which make up most of the sample, have fundamentally different attachment processes, and indeed this is likely to be investigated further in subsequent studies using this sample. Lastly, the small sample size in this study represents an important impediment to the inferences that can be drawn from these results, and a null finding is not uncommon under these circumstances.

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